Obesity in an Ageing Society

Implications for health, physical function and health service utilisation

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Key Findings

- Based on body mass index (BMI) measurements, 36% of Irish over 50s are obese and a further 43% are overweight.
- Based on waist circumference measurements, 52% of Irish over 50s are ‘centrally obese’, i.e., with a ‘substantially increased’ waist circumference, while a further 25% have an ‘increased’ waist circumference.
- Using BMI as an indicator of obesity, a higher proportion of men (38%) are obese than women (33%); however, using waist circumference as an indicator of obesity, a higher proportion of women (56%) have a ‘substantially increased’ waist circumference than men (48%).
- The prevalence of obesity in Irish men over 50 is comparable with US men over 50 (while English rates are much lower).
- The prevalence of obesity in Irish women over 50 is lower than among comparable women in the US, and broadly similar to the prevalence among older English women.
- There is a much stronger relationship between obesity and socioeconomic status for Irish women than for Irish men; for example, 39% of women in the lowest quintile of wealth are obese, in comparison to 24% of women in the highest wealth quintile.
- There are strong relationships between obesity, particularly central obesity, and cardiovascular diseases such as angina, heart failure and heart attack; 21% of centrally obese men report at least one cardiovascular disease compared to 14% of men with a normal waist circumference. Corresponding rates for women are 17% compared to 11%.
- Cardiovascular disease risk factors are more prevalent in those with central obesity. For example, 48% of those with central obesity report a doctor’s diagnosis of high blood pressure compared with 22% of those with a normal waist circumference. 11% of those with central obesity report a doctor’s diagnosis of diabetes in comparison with just 2.5% of those with a normal waist circumference.
- Chronic conditions such as arthritis are more common among obese individuals; for example, the prevalence of arthritis among obese women is 44%, compared with 25% of women with a normal weight.

- There is a clear relationship between obesity and objective measures of physical functioning in both men and women; for example, obese women walk over 10cm per second slower than normal weight women.
- Compared to those of normal weight, a lower proportion of obese men and women are current smokers.
- The relationship between obesity and physical activity is stronger in women than men. 47% of obese women report 'low' levels of physical activity compared to 30% of normal weight women.
- Obese women consume less alcohol and a lower proportion are problem drinkers compared to those of normal weight, with no association evident in men.
- Obese individuals visit their GP more frequently, take more medications, and a higher proportion report polypharmacy (i.e., concurrent use of five or more medications) than non-obese individuals.

Acknowledgements

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Contents

1 Introduction

Obesity is a chronic disease defined by the World Health Organisation (WHO) as a condition of abnormal or excessive fat accumulation, to the extent that health may be impaired (1). This excess fat mass is thought to lead to a chronic, low grade inflammation which is associated with an increased risk of ill-health such as metabolic and cardiovascular disease, musculoskeletal problems, decreased physical function, and some cancers (2).

Obesity prevalence has risen dramatically worldwide over the past 3-4 decades and is now considered a global epidemic (1, 3). Several societal factors have contributed to the rapid spread of obesity such as increasingly sedentary lifestyles and the widespread availability of energy dense foods in combination with a so-called ‘obesogenic environment’. However, the impact of obesity on health is complex, and differs, for example, according to age, sex and the trajectory of changes in body weight over time (1, 4).

Recent reports have highlighted the high rates of overweight and obesity in Irish children, with 19% of nine year olds reported to be overweight, and a further 7% obese, and 19% of three years olds classed as overweight and a further 6% obese (5, 6). However the prevalence of overweight and obesity is substantially higher in adults. The 2007 Survey of Lifestyle Attitudes and Nutrition in Ireland reported a prevalence of obesity of 32% in men and 31% in women aged 45 and over (7). More recently, in 2011, the National Adult Nutritional Survey indicated a prevalence of obesity of 42.1% in men and 30.9% in women aged 51-64. In men this was a four-fold increase from 10.7% in 1990 (8). While there is some evidence that obesity rates in both adults and children in England and other countries have stabilised in recent years (9), a recent analysis projects that Ireland will have the highest prevalence of both male and female adult obesity in Europe by 2030 (10).

The high prevalence of overweight and obesity in the Irish population have generated major discussion around health and economic policies for tackling what is now considered a national epidemic. Healthy Ireland, the national framework document for improved health and well-being in Ireland, is committed to increasing the number of Irish children and adults with a healthy weight by 6% and 5% by 2019 (11). As a result of the review of the National

Taskforce on Obesity (2005), a Special Action Group on Obesity (SAGO), comprising representatives from Government departments, agencies and other key stakeholders, was established in 2009. It is currently examining a range of measures designed to tackle the problem of obesity such as calorie counts on restaurant menus, alternative pricing and taxation strategies, and healthy eating guidelines.

Obesity has major health consequences through its association with cardiovascular diseases, musculoskeletal disorders, and impaired mobility and function. It is also associated with high mortality and an increased number of years lived with disability (12, 13). Obesity has significant economic consequences. In the Republic of Ireland, overweight and obesity are estimated to cost at least €1.13bn per annum to the economy through increased health services utilisation, work absenteeism and premature mortality (14). The direct costs associated with these conditions account for an estimated 2.7% of total health expenditure. These costs are comparable to the direct costs of stroke, the leading cause of disability in older Irish adults, which was estimated to account for 2-4% of total health expenditure in 2007 (15).

Given that the proportion of the Irish population over the age of 65 will double from 11% in 2006 to 22% in 2041 (16), the combination of a rapidly ageing population and an increasing prevalence of obesity and related co-morbidities across the lifespan will considerably increase care needs. The prevalence of obesity, its demographic and socioeconomic correlates, and its consequences for health and health services utilisation in older Irish adults has yet to be examined. The Irish Longitudinal Study on Ageing (TILDA) presents a unique opportunity to quantify the magnitude of the obesity crisis in the Irish over 50s and to investigate its associations with health, social and economic circumstances. High levels of obesity in the TILDA cohort have been previously highlighted (17). This report takes a closer look at what groups are most affected, what are the associations with various aspects of health and physical function, and how this impacts upon health service utilisation.

1.1 Data and Methods

The Irish Longitudinal Study on Ageing (TILDA) is a prospective study of community-dwelling older adults resident in the Republic of Ireland. Wave 1 of TILDA, undertaken between October 2009 and February 2011, collected extensive information on health, economic and social circumstances of 8175 participants over the age of 50. An additional 329 partners of participants under the age of 50 also took part in the study but have been excluded from this analysis.

Each participant undertook a Computer Aided Personal Interview (CAPI) and was asked to fill out a Self-Completion Questionnaire (SCQ) in their own time. They were then invited to take part in a comprehensive health assessment either in their own home or in a dedicated health centre. For participants who undertook a health assessment, height, weight and waist circumference were measured by a research nurse. This group (n=5856) forms the population sample for this report.[1]

All analysis are weighted to account for age, sex and educational attainment ensuring that the data is representative of the wider Irish over 50s population. Further details on population sampling and construction of analysis weights can be found in the TILDA Wave 1 design report (18). Wave 2 of TILDA was carried out between April 2012 and January 2013, and Wave 3 is currently in the field. The nurse-led health assessments are carried out at alternate waves (i.e., Waves 1, 3, 5, etc.), and thus objective measures of height and weight are currently available for Wave 1 only. Therefore, all analyses contained within this report are cross-sectional and it is not possible to identify the direction of associations or imply causality in the observed relationships. As Wave 3 data become available, we will be able to extend this analysis to examine trends in obesity among the over 50s in Ireland, as well as to examine the causal mechanisms underlying the relationships between obesity, health, physical functioning, health behaviours and health service utilisation.

1.2 Report Structure

This report utilises cross-sectional data from TILDA Wave 1. There are eight core sections outlining the prevalence and correlates of measured obesity in older Irish adults. Sections 2 and 3 document the prevalence of obesity in older Irish adults using body mass index and waist circumference and compares this prevalence to older adults in the US and England. Section 4 investigates the associations between obesity prevalence and demographic and socioeconomic characteristics. Section 5 examines the relationships between obesity and childhood circumstances such as socioeconomic position and exposure to adverse events. Sections 6-9 document the differences in cardiovascular and non-cardiovascular health, physical function, health behaviours and associated health service utilisation according to body mass index and waist circumference classification. Finally, Section 10 summarises the findings of the report and discusses implications for policy makers.

1 This is slightly larger sample than that analysed in the TILDA Wave 2 report (17), which was based on participants with measured height and weight at Wave 1 who also completed a computer aided personal interview at Wave 2.

2 Prevalence of Obesity in Older Irish Adults

Obesity is most commonly defined according to body mass index (BMI), calculated as weight in kilograms divided by height in metres squared (kg/m^2). WHO cut-offs are used to define persons as 'underweight', 'normal', 'overweight' and 'obese' according to their BMI (Table 2.1)(1).

Table 2.1. World Health Organisation body mass index classifications

Classification	BMI (kg/m^2)
Underweight	<18.50
Normal	18.50-24.99
Overweight	25.00-29.99
Obese	≥30.00

The use of BMI has been questioned in older adults as it does not reflect the age-associated changes in body composition such as loss of muscle mass or increase in fat mass deposited in the abdominal area (2). Waist circumference (WC) is therefore considered to be a more useful measure of excess fat in this population. The WHO use sex-specific cut-off values for WC which indicate increased and substantially increased risk of metabolic disease (Table 2.2) (19). 'Substantially increased' WC is also referred to as 'central obesity'.

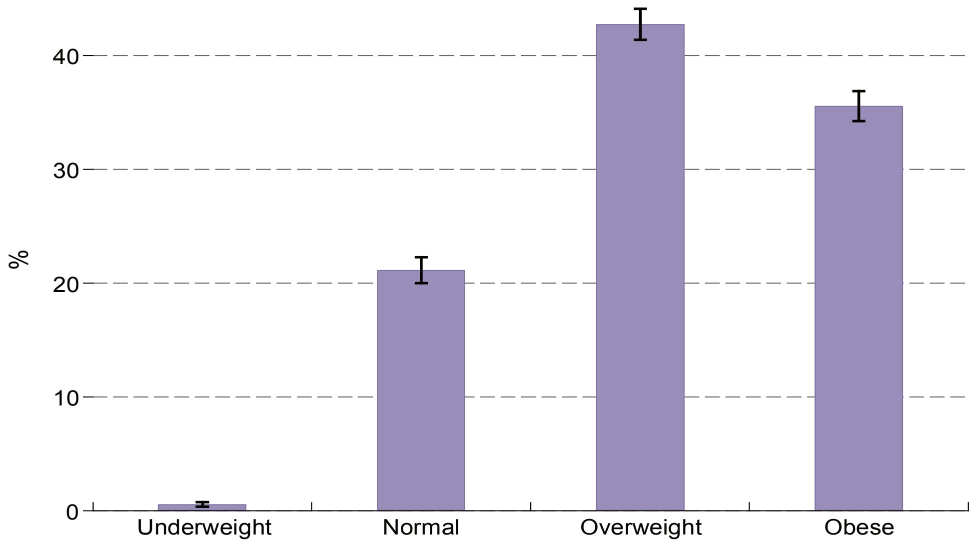
Table 2.2. World Health Organisation waist circumference classifications

Metabolic Risk Classification	Waist circumference (cm)	
	Men	**Women**
Normal	<94	<80
Increased	94-101	80-87
Substantially Increased	≥102	≥88

2.1 Measured Body Mass Index

Figure 2.1 illustrates the distribution of BMI according to the WHO cut-points. The mean BMI of TILDA participants is 28.8kg/m^2. Thirty-six per cent of the Irish over 50s population are classified as obese and a further 43% are overweight; just 21% of the population have a normal BMI. Less than 1% of the population is classified as underweight. This group are excluded from sub-analyses in later sections of the report as there are too few cases to establish significant differences between the underweight group and the other BMI classifications.

Figure 2.1. Distribution of body mass index by WHO classification



Note. N = 5856; Missing obs = 0; Error bars correspond to 95% confidence intervals

Table 2.3 describes the distribution of BMI according to age and sex. A greater proportion of older Irish men are obese than women (38% vs. 33%). The prevalence of obesity does not differ by age group, with a similar proportion of those aged 75 years and over classified as obese compared to those aged 50-64 years or 65-74 years. Overweight is similar across all age groups, and lower in women (40%) than men (46%).

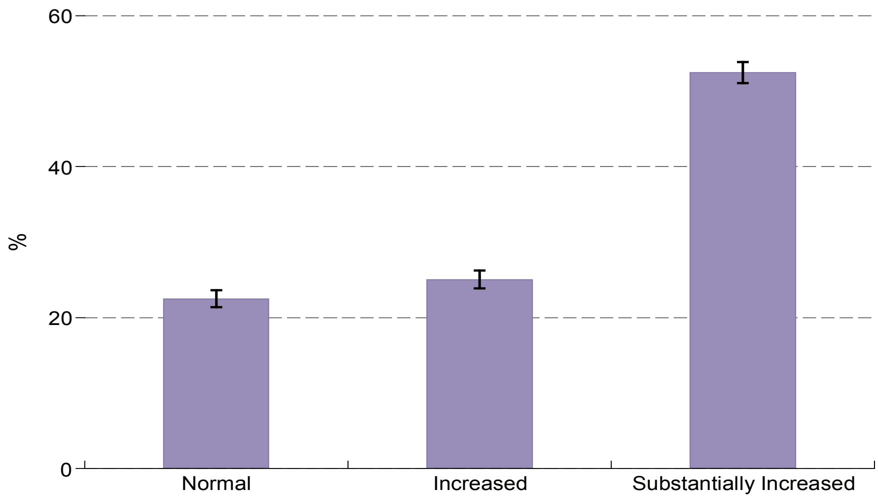
Table 2.3. Body mass index classification by age and sex

	Underweight		Normal		Overweight		Obese	
	%	[95% CI]	%	[95% CI]	%	[95% CI]	%	[95% CI]
				Men				
50-64	1	[0, 1]	16	[14, 18]	46	[44, 49]	38	[35, 40]
65-74	1	[0, 2]	14	[12, 17]	45	[41, 49]	40	[36, 44]
>=75	1	[0, 2]	17	[13, 22]	46	[40, 51]	36	[31, 42]
Total	***1***	***[1, 1]***	***16***	***[14, 17]***	***46***	***[44, 48]***	***38***	***[36, 40]***
				Women				
50-64	0	[0, 0]	27	[25, 29]	40	[38, 43]	32	[30, 34]
65-74	0	[0, 1]	24	[21, 27]	40	[36, 44]	35	[32, 39]
>=75	0	[0, 2]	26	[22, 31]	39	[33, 44]	34	[29, 39]
Total	***0***	***[0, 1]***	***26***	***[24, 28]***	***40***	***[38, 42]***	***33***	***[31, 35]***

2.2 Measured Waist Circumference

Figure 2.2 illustrates the distribution of WC by WHO classification. Mean WC is 96.2cm. Fifty-two per cent of the Irish over 50s population are classified as centrally obese based on their WC; a further 25% are at an 'increased risk' of metabolic disease. Just 22% have a normal WC.

Figure 2.2. Distribution of waist circumference by WHO classification



Note. N = 5856; Missing obs = 0; Error bars correspond to 95% confidence intervals

A greater proportion of women than men are classified as centrally obese (56% vs. 48%; Table 2.4). Prevalence of 'increased' WC is slightly higher in men (26%) than women (24%); however a greater proportion of men have a 'normal' WC (25% vs. 20%). In both men and women the prevalence of central obesity is lowest in those aged 50-64 years.

Table 2.4. Waist circumference classification by age and sex

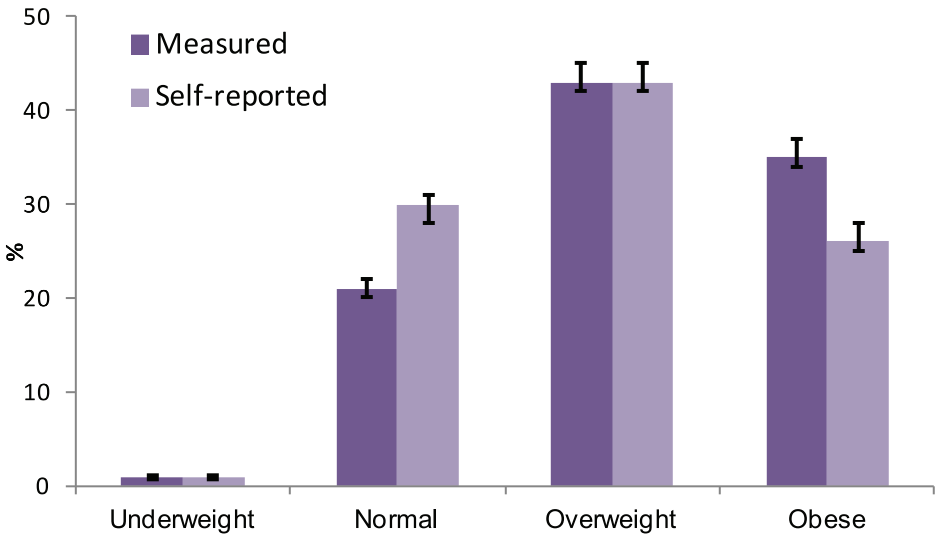
	Normal		Increased		Substantially Increased	
	%	[95% CI]	%	[95% CI]	%	[95% CI]
Men						
50-64	28	[25, 30]	28	[25, 30]	45	[42, 47]
65-74	22	[19, 26]	25	[21, 28]	53	[50, 57]
>=75	20	[16, 25]	24	[20, 29]	56	[50, 61]
Total	***25***	***[23, 27]***	***26***	***[25, 28]***	***48***	***[47, 50]***
Women						
50-64	23	[21, 25]	25	[23, 27]	52	[49, 54]
65-74	16	[14, 19]	25	[22, 28]	59	[55, 62]
>=75	16	[13, 20]	18	[15, 22]	65	[60, 70]
Total	***20***	***[19, 22]***	***24***	***[22, 25]***	***56***	***[54, 58]***

2.3 Self-Reported Body Mass Index

Many population-based studies rely on self-reported height and weight to calculate BMI due to its convenience and low cost. While self-reported and measured height and weight have been shown to correlate well, individuals generally overestimate their height and underestimate their weight (20). The use of self-reported measures is particularly problematic in older populations, primarily due to age-related decreases in measured height (21, 22). This is likely to cause an even greater overestimation of height in older age as individuals may report their recalled height when measured as a young adult.

Prior to having their height and weight measured during the health assessment, a subsample of 3953 participants self-reported their height and weight.[2] The mean BMI calculated from self-reported height and weight is 27.6kg/m^2 and from measured height and weight is 28.8kg/m^2. Figure 2.3 shows the weighted distribution of BMI using measured and self-reported height and weight in this subsample. The prevalence of obesity using self-reported height and weight is 26%, 10 percentage points lower than that calculated from measured height and weight. The prevalence of overweight is similar between the two methods at 43%.

Figure 2.3. Distribution of body mass index calculated from measured and self-reported height and weight



In this subsample, both overestimation of height and underestimation of weight contribute to the lower mean BMI and lower prevalence of obesity calculated from self-reported height and weight (Table 2.5). Height is overestimated by a mean of 2.0cm in the total subsample.

2 Self-reported estimates of WC are not collected in TILDA.

This overestimate increases from 1.2cm in 50-64 year olds to 4.3cm in those aged 75+ (figures not shown). Women overestimate their height to a greater extent than men (mean 2.4cm, 1.5% vs. 1.6cm, 0.9%). Weight is underestimated by a mean of 1.3kg in the total group; this does not differ by age group but is greater in men (mean 2.0kg, 2.3%) than women (mean 0.7kg, 1%).

Table 2.5. Absolute and relative difference between measured and self-reported height and weight by age and sex

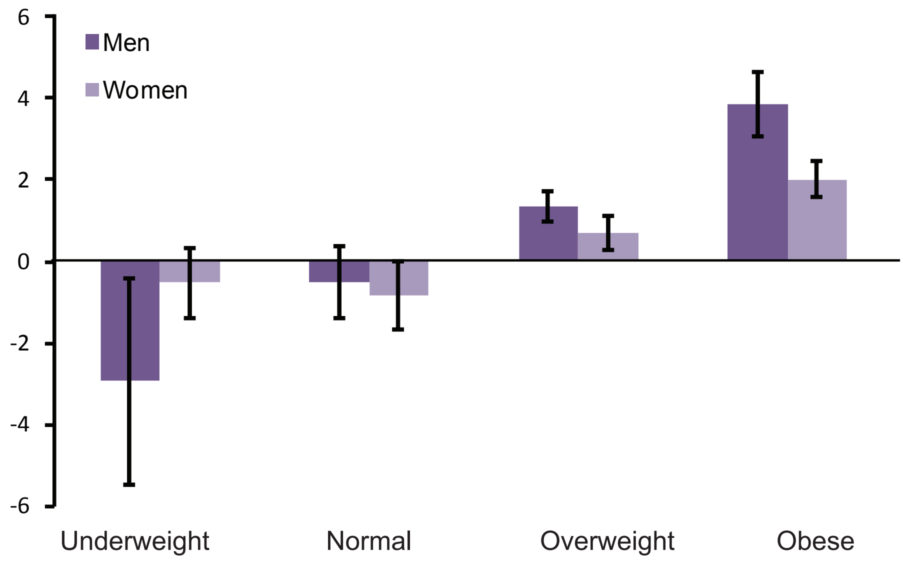
	Height Difference* (cm)				Weight Difference* (kg)			
	Men		Women		Men		Women	
	Mean [95% CI]	%ᶧ	Mean [95% CI]	%ᶧ	Mean [95% CI]	%ᶧ	Mean [95% CI]	%ᶧ
50-64	-0.7 [-1.0, -0.4]	-0.4	-1.6 [-1.9, -1.3]	-1.0	2.2 [1.7, 2.7]	2.5	0.7 [0.3, 1.0]	1.0
65-74	-2.4 [-2.7, -2.0]	-1.4	-2.3 [-2.7, -2.0]	-1.5	1.8 [1.3, 2.3]	2.1	0.4 [-0.2, 1.0]	0.6
75+	-4.1 [-4.7, -3.5]	-2.4	-4.5 [-5.5, -3.5]	-2.9	1.5 [0.9, 2.1]	1.8	0.9 [-0.1, 1.7]	1.3
Total	***-1.6 [-1.9, -1.4]***	***-0.9***	***-2.4 [-2.7, -2.1]***	***-1.5***	***2.0 [1.7, 2.4]***	***2.3***	***0.7 [0.4, 0.9]***	***1.0***

*Measured – self-reported

ᶧ% = ((measured – self-reported)/(measured))*100

When analysed by measured BMI categories, men classified as obese underestimate their weight by a mean of 3.9kg compared to no underestimate in men with a 'normal' BMI. Similarly obese women underestimate their weight by a mean of 2kg. Overweight men and women underestimate their weigtht by a mean of 1.4kg and 0.7kg respectively (Figure 2.4).

Figure 2.4. Difference between measured and self-reported weight by measured body mass index classification and sex



2.4 Discussion

Overweight and obesity are highly prevalent in older Irish adults; just 16% of men and 26% of women have a normal BMI. Similarly, over half of the over 50s population are classified as centrally obese. As TILDA is the first study to look specifically at obesity in the over 50s in Ireland, historical prevalence data is not available for direct comparison. Previous reports from the Irish Universities Nutrition Alliance indicate that in men aged 51-64, obesity has quadrupled from 10% in 1990 to 42% in 2011 (8). They also reported that obesity prevalence in older women had remained stable at approximately 30% over the same time period. Furthermore, the significantly higher prevalence of obesity in older Irish men compared to women is at odds with international evidence where obesity traditionally affects older women to a greater extent than older men (23). Obesity prevalence has been shown to increase with age, peaking at about 55 years for men and 60 years for women before declining in old age (24). This decline is not evident in the TILDA sample, where the prevalence of obesity remains similar in those aged 75 and over and those aged 50-65 years old. However, a greater proportion of older Irish women are ‘centrally obese’ than older Irish men, and there is evidence that WC increases with age above 50 in both men and women.

The discrepancies between self-reported and measured height and weight presented here are consistent with previous Irish and international evidence. A recent study utilising longitudinal data at three time points from the Survey of Lifestyle, Attitudes and Nutrition (SLAN 1998, 2002 and 2007) indicates that Irish adults underestimate their weight across all categories of BMI and suggests that this underestimate increased significantly in obese men and both overweight and obese women between 1998 and 2007 (25). Specific to older adults, analysis from the third National Health and Nutrition Examination Survey (NHANES III) in the US indicates significant discrepancies in BMI calculated from self-reported data in adults aged 60 and over, with particular concerns highlighted in relation to the overestimation of height (20). Contrary to the finding that older Irish women overestimate their height to a greater extent than men, the NHANES III study observed no difference in the overestimate between men and women aged 60 an over. BMI prevalence calculated from self-reported height and weight is likely to be underestimated and this should be considered when interpreting such data. Where measured height and weight is unattainable, efforts should be made to correct for the discrepancies between the two methods (24).

3 International Comparisons of Obesity Prevalence

While it is recognised that obesity prevalence increases in older populations, there is little information on international obesity prevalence in those aged 50 and over. Data from the 2004 Survey of Health, Ageing and Retirement in Europe (SHARE) indicates an obesity prevalence of approximately 18% in women and 16% in men aged 50 and over (26). However these findings are based on self-reported height and weight and are restricted to ten participating countries which do not include the UK or Ireland.

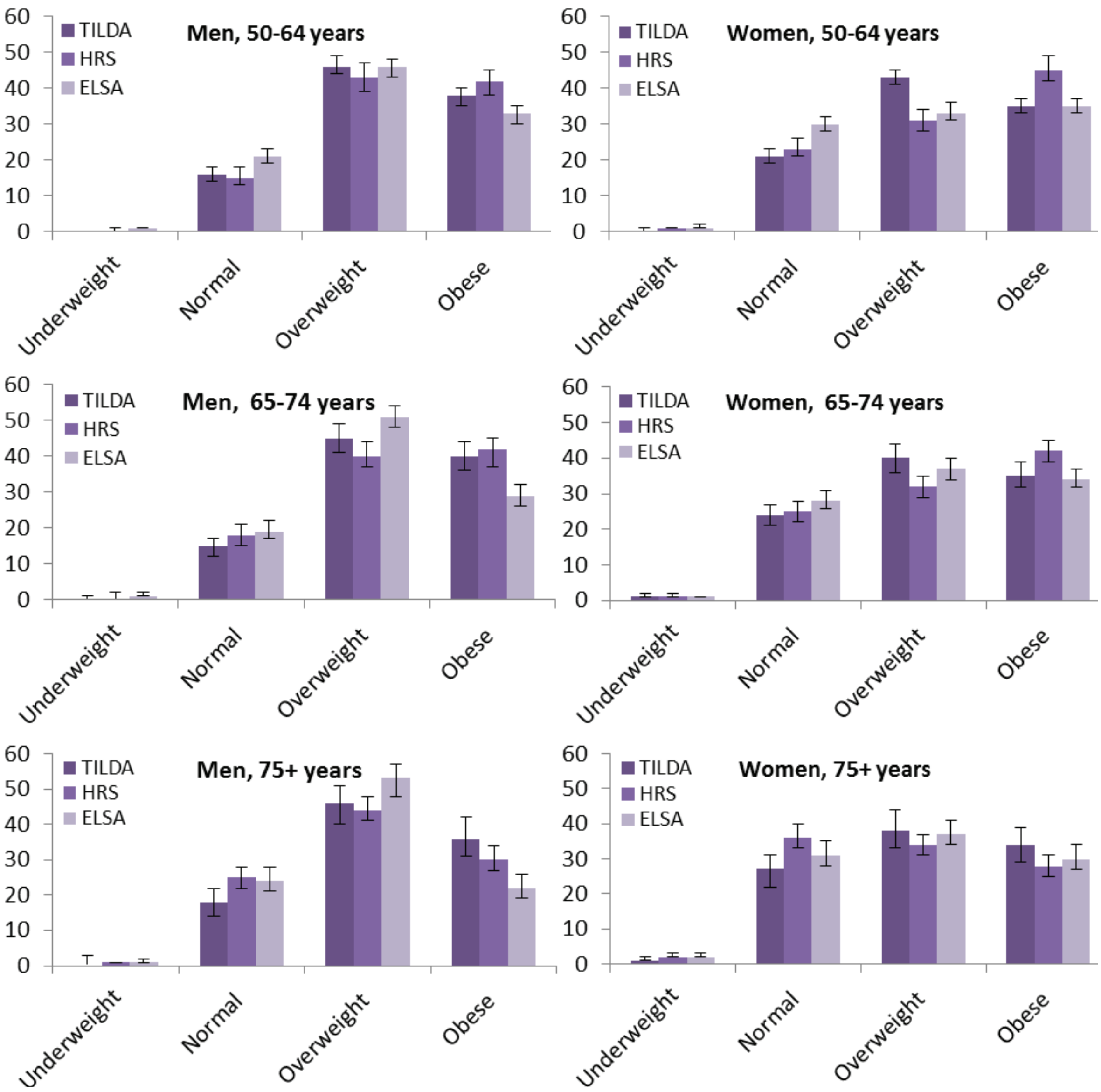
TILDA is a member of the Health and Retirement Study (HRS) family, an international collaboration of harmonized longitudinal studies on ageing. The HRS began in 1992 and currently collects objective measures of height, weight and WC on a subsample of US adults aged 51 and over at each biennial wave of data collection. The initial wave of HRS recruited 12652 respondents born between 1931 and 1942. The study was later merged with the Assets and Health Dynamics Among the Oldest Old (AHEAD) studies and replenished at each wave. Wave 9 was completed in 2008 and included 17217 respondents, 6931 of whom consented to have physical measures taken (http://hrsonline.isr.umich.edu). The English Longitudinal Study on Ageing (ELSA) commenced in 2002 and carries out a health assessment including objective measures of height, weight and WC at alternate waves of data collection. The initial wave of ELSA recruited 11440 respondents aged 50 and over (27). During Wave 4 of ELSA, completed between 2008 and 2009, 11050 respondents were interviewed, with 8641 participating in a home based nurse assessment (28).

The following analysis compares the prevalence of obesity between Irish, English and US adults aged 50 and over using BMI and WC measured at TILDA Wave 1 (2009-2011), HRS Wave 9 (2008) and ELSA Wave 4 (2008-2009). While the TILDA data were collected approximately two years after the ELSA and HRS data, and thus comparisons must be treated with caution, the availability of data on measured BMI and WC across the three countries allows us to examine the extent to which the Irish over 50s are comparable to their English and US counterparts in terms of obesity and central obesity.

3.1 Body Mass Index

Figure 3.1 illustrates the distribution of BMI by age and sex in each of the three studies. In men, the prevalence of obesity is similar between Ireland and the US at all ages while the prevalence of obesity is considerably lower among English men. Rates of overweight in Irish men do not differ to those in the US or England in any age group studied. In women, the prevalence of obesity in the Irish population is similar to that in England at all age groups; rates of obesity are lower in Irish than US women aged 50-74 years and similar between Irish and US women aged 75+. Prevalence of overweight in Irish women is higher than the US or England in 50-64 year olds and remains higher than the US in 65-74 year olds. There are no differences between countries in the prevalence of overweight and obesity for women in the 75+ age group.

Figure 3.1. Distribution of body mass index in TILDA, HRS and ELSA by age and sex



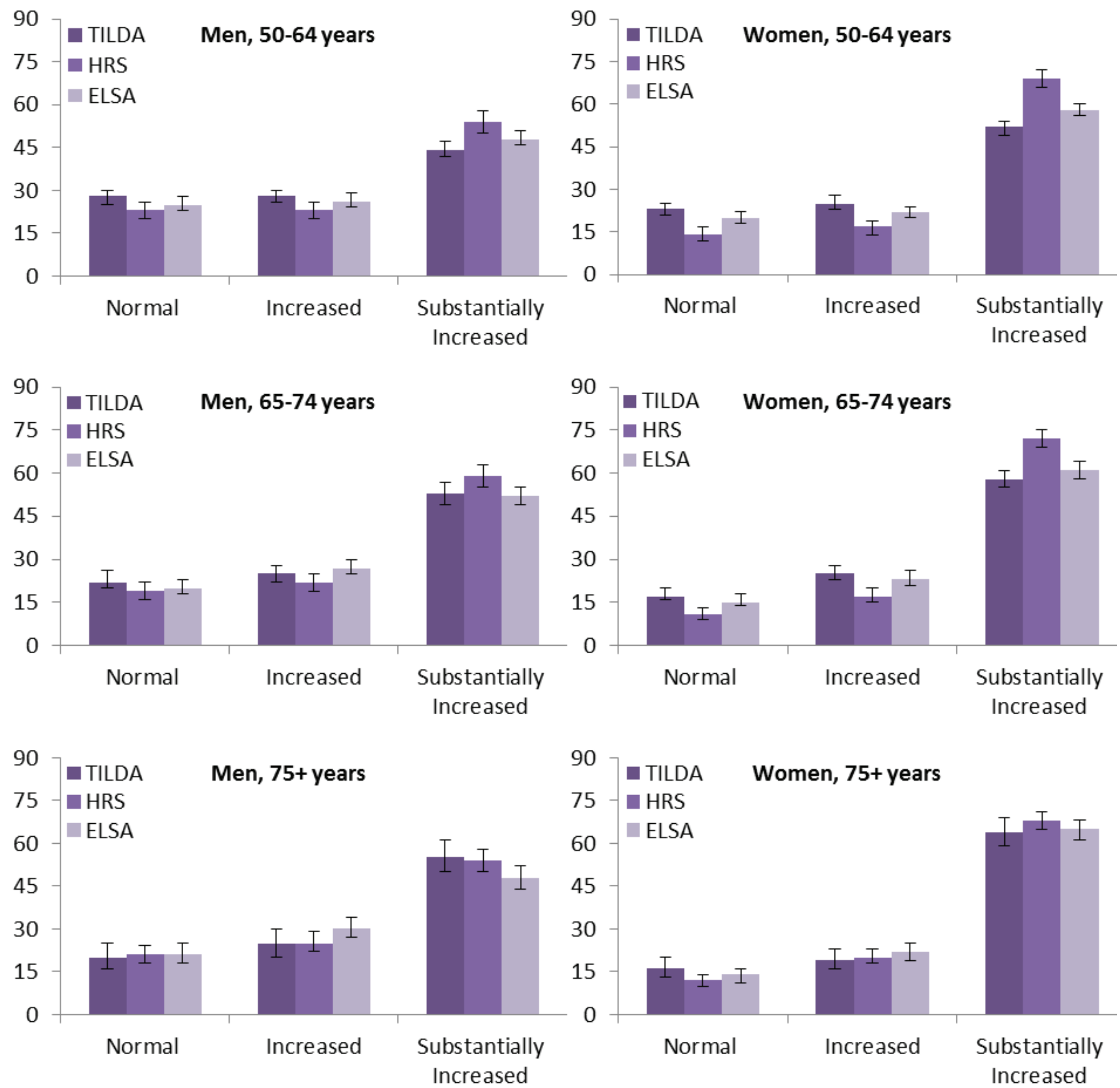
3.2 Waist Circumference

WC distribution does not differ between Irish and English men over the age of 50 (Figure

3.2). Irish men aged 50-64 have a higher prevalence of ‘increased’ WC and a lower prevalence of ‘substantially increased’ WC than their US counterparts. No differences are observed between countries in the 75+ age group for men.

Compared to the US and England, Irish women aged 50-64 have a higher prevalence of ‘increased’ and a lower prevalence of ‘substantially increased’ WC. In 65-74 year old women WC distribution is similar between Ireland and England; US women have the lowest prevalence of ‘increased’ and the highest prevalence of ‘substantially increased’ WC. As with men, no differences in WC classification are observed in the 75+ age group for women.

Figure 3.2. Distribution of waist circumference in TILDA, HRS and ELSA by age and sex



3.3 Discussion

As noted, the ELSA and HRS data used in this analysis were collected in 2008 and thus are not directly comparable to Wave 1 of TILDA which was collected between 2009 and 2011. Nonetheless, some tentative conclusions may be drawn. Prevalence of overweight, obesity and central obesity are similar in Irish men compared to men in the US. In women, obesity prevalence is generally similar across the Irish and English populations and substantially higher in the US.

The similarities between the BMI profile of men in TILDA and the HRS is concerning from an Irish perspective given that the obesity epidemic was first evident in the US and remains higher there at all ages compared to other developed countries (4). Though comparative international data from previous years is not available, crude comparisons indicate that the US obesity epidemic preceded that of Ireland. For example, in 1990 the estimated prevalence of obesity measured in Irish men aged 18-64 was 7.8% (29) compared to 19.9% in US men aged 20-74 measured during the period from 1988-1994 (30). Corresponding rates for women were 13.2% in Ireland and 24.9% in the US. This suggests that the TILDA sample did not experience the same levels of obesity as younger adults compared to their American counterparts. However, this does not explain why the prevalence of obesity in older Irish women is more favourable in comparison with their counterparts in the US, or why older Irish men have a substantially higher prevalence of obesity than their English counterparts. Further research is necessary to unpick the multitude of factors driving these differences across countries.

4 Demographic and Socioeconomic Correlates of Obesity

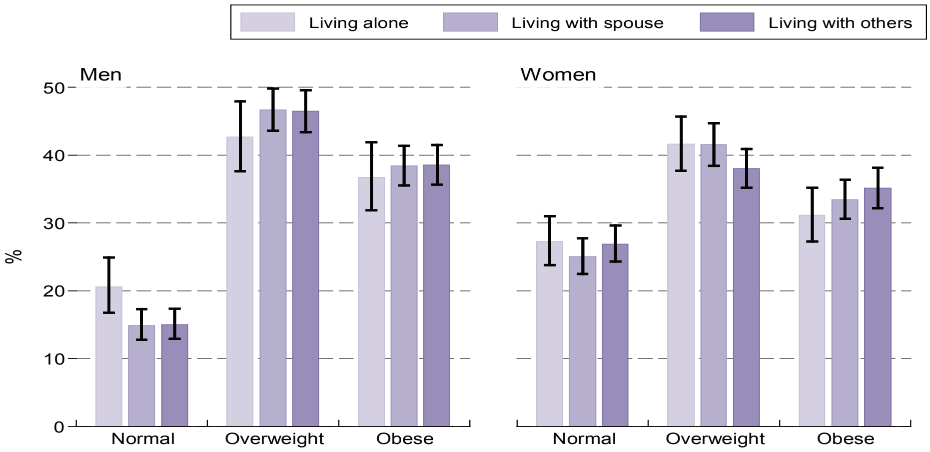
The obesity epidemic is apparent in all sectors of society; however it is more exaggerated in certain demographic and socioeconomic groups. Internationally, associations have been observed between obesity prevalence and geographical location (31), marital status (32) and social network characteristics (33). A strong negative association between obesity and socioeconomic status is well established in women in developed countries, with inconsistent findings observed in men (9, 34). In particular, educational attainment and occupation are negatively associated with obesity, while obese persons also earn lower wages (35). Previous research in the TILDA sample has shown lower rates of employment in obese women but not men (36). This section of the report describes the prevalence of obesity according to demographic and socioeconomic factors in older Irish adults.

4.1 Obesity and Demographic Characteristics

Figure 4.1 illustrates the distribution of BMI according to marital status, household composition and household location in the TILDA sample. Prevalence of obesity is not associated with marital status in men or women; however, men who were never married have a lower prevalence of overweight (36%) than men who are either married (47%) or widowed (51%). Neither household composition nor household location is associated with overweight or obesity in men. Obesity is more prevalent in women living in rural areas compared to those living in Dublin city or county (36% vs. 29%) but not other urban areas. Broadly similar associations are found with WC (Appendix Figure A1). In addition, a greater proportion of men living in a rural area are centrally obese compared to those living in Dublin city and county (52% vs. 43%), while women who are widowed have a higher prevalence of central obesity compared to all other groups (66% vs. 50-54%).

Figure 4.1. Distribution of body mass index by marital status, household composition, household location and sex

Note. N = 5824; Missing obs = 32; Error bars correspond to 95% confidence intervals



Note. N = 5824; Missing obs = 32; Error bars correspond to 95% confidence intervals

Note. N = 5819; Missing obs = 37; Error bars correspond to 95% confidence intervals

4.2 Obesity and Socioeconomic Status

For the purposes of this report, three variables are used to approximate the socioeconomic status (SES) of TILDA participants.

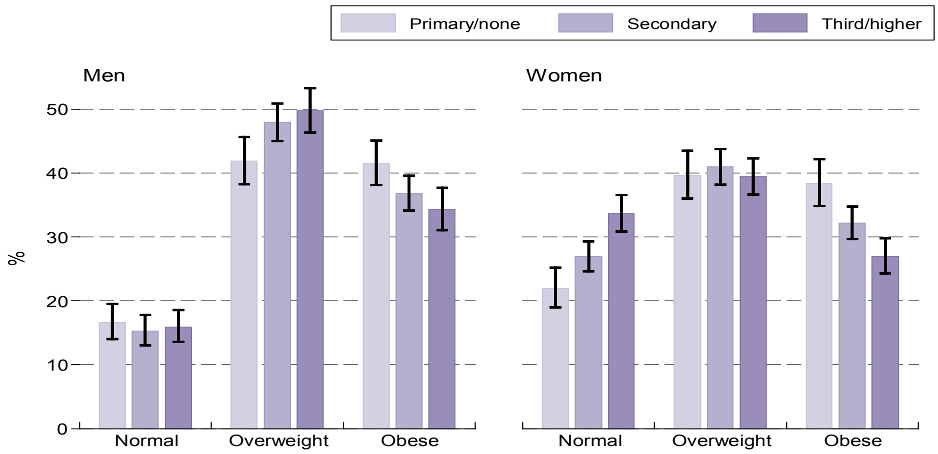
- **Educational attainment** is classified as 'Primary/None', 'Secondary' or 'Third/Higher'.
- **Employment status** is classified as 'Employed' 'Retired' or 'Other'. 'Other' includes those who are unemployed, permanently sick or disabled, looking after home or family, or in education or training.
- **Household Housing Wealth** is chosen as an indicator of overall wealth as it is available for most participants; housing wealth data is missing for 345 participants compared to income data which is missing for 1539 participants. Wealth is also a more appropriate measure of economic resources than income in older populations where those who are retired may report low levels of income despite having accumulated a large amount of wealth. For this analysis, household housing wealth is partitioned into sex-specific quintiles, with quintile 1 representing the poorest 20% and quintile 5 representing the richest 20%.

Figure 4.2 illustrates obesity prevalence by SES domain in men and women. Prevalence of obesity is higher in men with a lower education (41%) compared to those with third level qualifications (34%) but does not differ by employment status or housing wealth. Conversely, 50% of men with higher education are overweight compared to 42% of those with primary level or no education. There is a trend for a higher prevalence of overweight in men who are employed or retired or in the highest compared to the lowest wealth quintile.

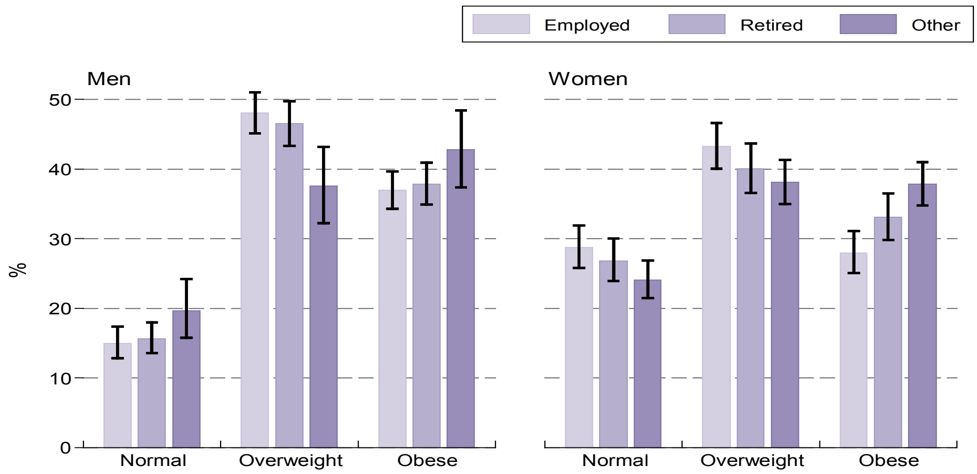
Lowest rates of obesity are observed among women who report a higher SES, namely those with a third level education, in current employment or with greatest housing wealth. The largest difference is seen with housing wealth, where the prevalence of obesity is 39% in the lowest quintile compared to 24% in the highest quintile. There are no associations evident between overweight and SES in women.

Regarding SES and WC, central obesity is higher in men with primary or no education compared to those with secondary or higher education, and a higher proportion of retired men are centrally obese compared to employed men. In women, associations between WC and SES are similar to those found with BMI (Appendix Figure A2).

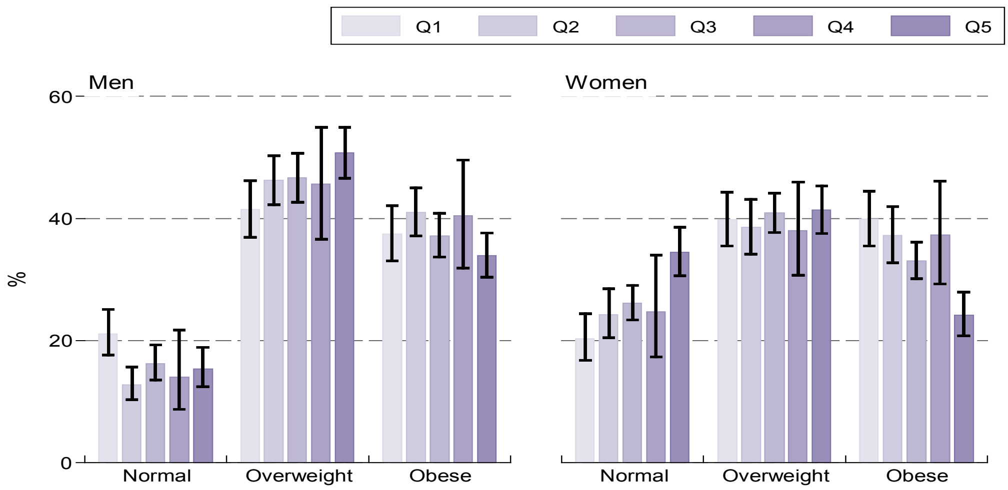
Figure 4.2. Distribution of body mass index by educational attainment, employment status, housing wealth and sex



Note. N = 5822; Missing obs = 34; Error bars correspond to 95% confidence intervals



Note. N = 5824; Missing obs = 32; Error bars correspond to 95% confidence intervals



Note. N = 5511; Missing obs = 345; Error bars correspond to 95% confidence intervals

To investigate if a particular domain of SES is driving the associations with BMI, a multinomial logistic regression analysis was carried out with 'normal' BMI classification defined as the reference group. Age, educational attainment, employment status and household housing wealth were included in the model, which was run separately for men and women. Results indicate that education, employment status and housing wealth are independently associated with obesity in women; women in the lowest quintile of housing wealth are 2.3 times more likely to be obese compared to those in the highest quintile of housing wealth. In men, there are no associations between BMI and SES after adjustment for other socioeconomic factors (Table 4.1). There are no associations between WC and SES in men, while similar associations are found between WC, housing wealth and education in women (Appendix Table A3).

Table 4.1. Results of logistic regression analysis investigating the association between socioeconomic status and body mass index classification by sex

	Men		**Women**	
	Odds Ratio [95% CIs]		**Odds Ratio [95% CIs]**	
	Overweight	**Obese**	**Overweight**	**Obese**
Age	0.99 [0.97, 1.01]	0.99 [0.97, 1.01]	1.00 [0.98, 1.01]	0.99 [0.98, 1.01]
Education				
Third/Higher	*Ref.*	*Ref.*	*Ref.*	*Ref.*
Secondary	1.05 [0.79, 1.40]	1.13 [0.84, 1.52]	1.34 [1.09, 1.65]	1.35 [1.07, 1.69]
Primary/None	0.88 [0.63, 1.23]	1.19 [0.85, 1.64]	1.53 [1.17, 2.00]	1.76 [1.32, 2.35]
Employment Status				
Employed	*Ref.*	*Ref.*	*Ref.*	*Ref.*
Retired	0.72 [0.51, 1.04]	1.09 [0.78, 1.54]	0.94 [0.70, 1.26]	1.24 [0.90, 1.71]
Other	1.12 [0.81, 1.56]	1.03 [0.72, 1.46]	0.93 [0.72, 1.20]	1.36 [1.05, 1.77]
Household Housing Wealth				
Highest Quintile	*Ref.*	*Ref.*	*Ref.*	*Ref.*
4th	1.00 [0.54, 1.85]	1.28 [0.68, 2.40]	1.22 [0.76, 1.98]	1.92 [1.11, 3.32]
3rd	0.91 [0.64, 1.30]	1.00 [0.70, 1.44]	1.22 [0.94, 1.57]	1.59 [1.19, 2.14]
2nd	1.19 [0.81, 1.75]	1.39 [0.95, 2.03]	1.21 [0.88, 1.66]	1.84 [1.30, 2.60]
Lowest Quintile	0.68 [0.46, 0.99]	0.77 [0.53, 1.13]	1.48 [1.07, 2.03]	2.26 [1.60, 3.18]

'Normal' BMI is the reference group

4.3 Discussion

In terms of demographic correlates of obesity, there is some evidence that obesity prevalence is higher in rural areas in comparison with Dublin city and county. A similar inequality has been noted in England and the US and may be explained by poorer access to amenities which reduces opportunities to engage in physical activity or make healthy food choices (37, 38). The definition of 'rural' is arbitrary and may mask significant heterogeneity regarding access to amenities that may encourage healthier lifestyle choices. More detailed research on factors such as proximity to the nearest urban area and access to amenities such as supermarkets, food outlets, green spaces, etc. may identify rural regions that are particularly at risk.

There is no association between obesity as defined by BMI and marital status in older Irish adults. However, older Irish women who are widowed have an increased prevalence of central obesity compared to other groups. Cross-sectional data from the 2004 HRS suggests that in the US, obesity prevalence is highest in women who are single/never married and in men who are currently married (32). Cross-sectional data analysis does not capture transitions in marital status which may be a positive or negative experience depending on the individual circumstances. The immediate effects of marital transitions such as separation, divorce or widowhood on BMI, WC and other health indicators in the TILDA cohort will be investigated as further waves of the data become available.

Socioeconomic variables are strongly associated with obesity in women whereby those with a higher education, in current employment and with greatest wealth have a substantially lower prevalence of obesity compared to women of low SES. There are no persistent associations between obesity and SES in older Irish men, although there is some evidence that the prevalence of overweight is higher in men with greater wealth. This gender inequality is in line with international evidence (39) and while not fully understood, one theory is that thinness is more socially desirable in women while larger body size in men may be indicative of physical dominance and prowess (34). Such negative perceptions of overweight and obesity in women may explain why obese women earn lower wages (40) and are less likely to be employed, as evidenced in TILDA (36).

5 Obesity and Early Childhood Circumstances

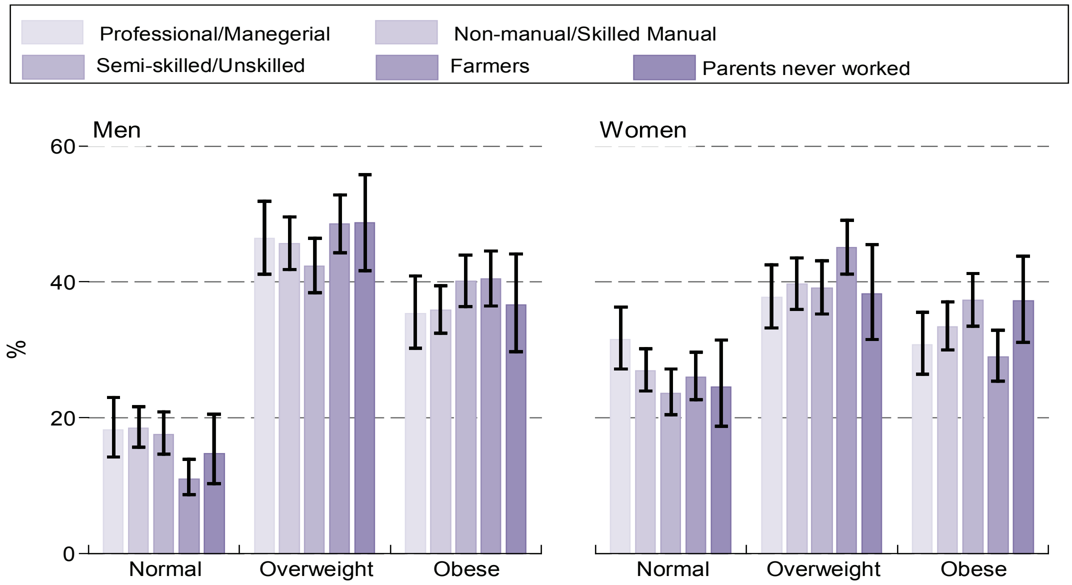
A growing body of research exists linking early life experiences and circumstances to health status and SES in later life. For example, the Barker hypothesis of developmental origins of disease suggests that events and circumstances such as maternal health behaviours and nutrition during pregnancy can influence development in utero, which impacts later life health (41). The 'accumulation of risk' hypothesis has also been explored which posits that individuals who experience prolonged and cumulative disadvantage such as low SES, childhood poverty or poor health at critical life stages fare badly on later life health outcomes compared to those who, for example, were consistently less disadvantaged or transitioned out of low SES in adulthood (42). There is some evidence to suggest that factors including birth weight, childhood physical activity and parental fatness may specifically predict the development of obesity in adulthood (43). One of the strengths of TILDA is the availability of retrospective information on the participants' childhoods, thus allowing us to investigate whether early childhood factors such as parental SES or exposure to traumatic experiences are associated with obesity in older Irish adults.

5.1 Childhood SES

While TILDA does not capture information on maternal pregnancy health status and behaviours, child birth weight or history of breastfeeding, participants are asked numerous questions pertaining to family life and circumstances during childhood. In terms of SES, information is collected on fathers occupation and educational attainment, and whether the participant lived in a rural or urban area when they were about age 14. Father's occupation is used to assign a childhood social class according to the Central Statistics Office Census classification (44). For the purposes of this analysis, five categories of social class are compared; professional or managerial; non-manual or skilled manual; semi-skilled or unskilled; farmers, and those whose parents never worked.

Figure 5.1 illustrates the distribution of BMI by father's social class in men and women. Overweight and obesity are not associated with father's social class in men, although a lower proportion of men whose fathers were farmers have a normal BMI compared to those whose fathers were in higher social classes. A lower proportion of women whose fathers were farmers are obese (29%) compared to those whose fathers did skilled or semi-skilled jobs (37%), with no differences noted in the overweight category. In contrast to the findings for BMI, there are no associations noted between father's social class and WC for women (Appendix Figure A4).

Figure 5.1. Distribution of body mass index by sex and father's social class

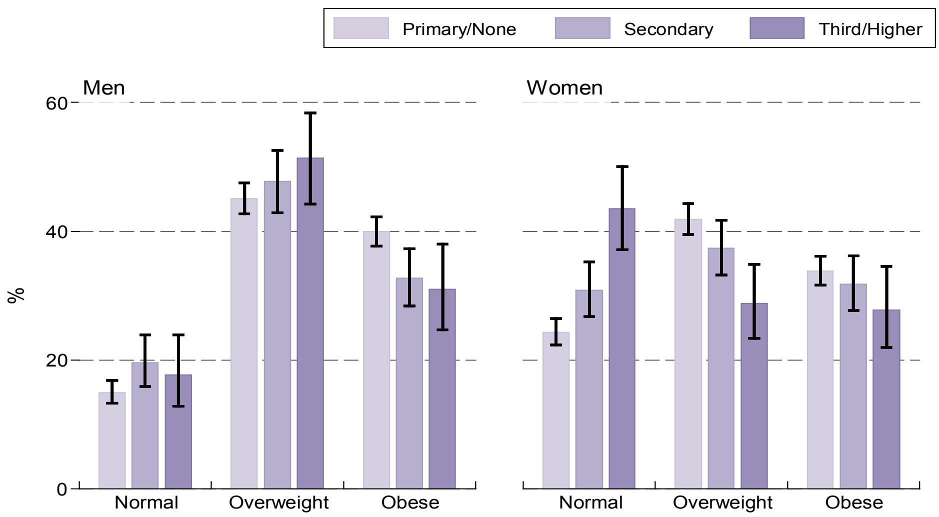


Note. N = 5589; Missing obs = 267; Error bars correspond to 95% confidence intervals

In terms of the relationship between obesity and father's educational attainment (Figure 5.2), obesity is associated with fathers educational attainment for men only, although a higher proportion of women with poorly educated fathers are overweight than women whose fathers had completed third level education. For both men and women, the prevalence of central obesity is highest among those whose fathers had primary or no education (Appendix Figure 5).

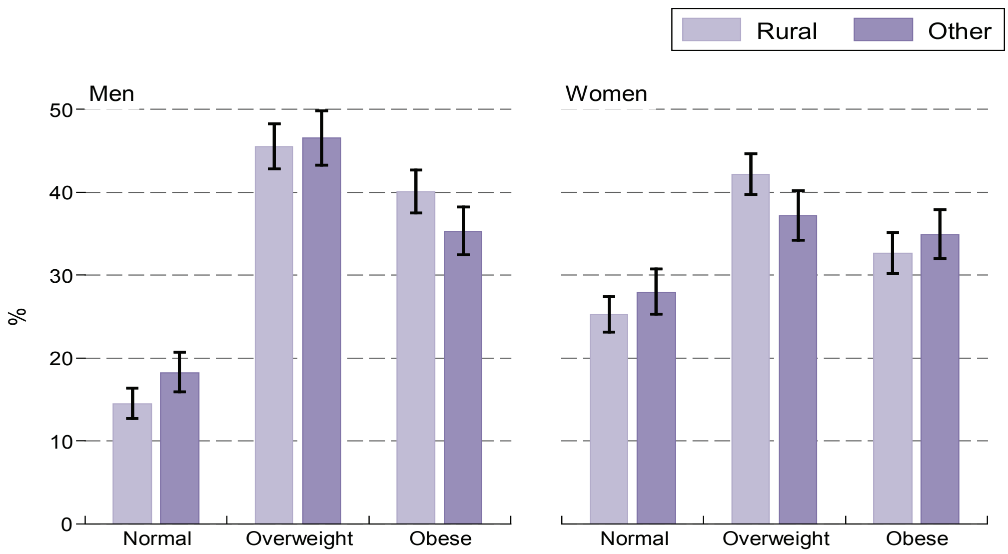
Growing up in a rural area is not associated with BMI in either men or women (Figure 5.3). A lower proportion of men who grew up in a rural area are centrally obese than those who did not grow up in a rural area (51% vs. 44%; Appendix Figure A6).

Figure 5.2. Distribution of body mass index by sex and father's educational attainment



Note. N = 5346; Missing obs = 510; Error bars correspond to 95% confidence intervals

Figure 5.3. Distribution of body mass index by location of upbringing and sex



Note. N = 5822; Missing obs = 34; Error bars correspond to 95% confidence intervals

5.2 Adverse Childhood Events

Exposure to traumatic events such as childhood abuse, whether physical, psychological or sexual in nature has been linked to poor health, including obesity, in later life (45). Several questions relating to adverse childhood events (ACEs) are included in the TILDA Wave 1 self-completion questionnaire (Table 5.1).

Table 5.1. TILDA questions relating to adverse childhood events

- *Consider your health while you were growing up, from birth to age 14. Would you say that your health during that time was excellent, very good, good, fair, or poor?*
- *Now think about your family when you were growing up, from birth to age 14. Would you say your family during that time was pretty well off financially, about average, or poor?*
- *Before you were 18 years old, did either of your parents drink or use drugs so often that it caused problems in the family?*
- *Before you were 18 years old, were you ever physically abused by either of your parents?*
- *Before you were 18 years old, were you ever physically abused by anyone other than your parents?*
- *Before you were 18 years old, were you ever sexually abused by either of your parents?*
- *Before you were 18 years old, were you ever sexually abused by anyone other than your parents?*

Responses to these questions were summed to create an index of adverse childhood events ranging from 0-5 based on the following adverse events:

1. Fair or poor health in childhood
2. Family being financially poor
3. Parental substance abuse
4. Physical abuse by parent or other
5. Sexual abuse by parent or other

Table 5.2 indicates the prevalence of each ACE in men and women. A greater proportion of men than women report experiencing childhood poverty with no gender differences noted for other adverse events.

Table 5.2. Prevalence of adverse childhood events in men and women

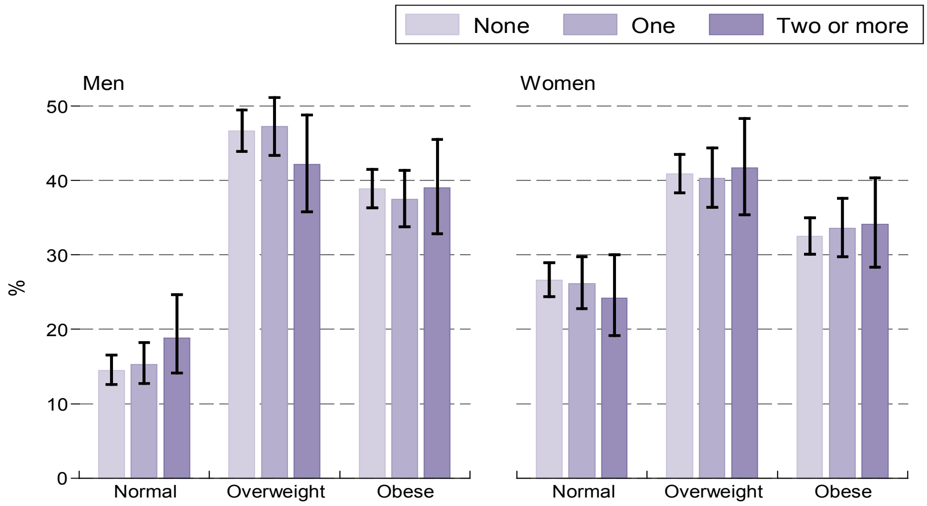
	Men		Women	
	%	[95% CIs]	%	[95% CIs]
Fair or poor health	6.1	[5.2, 7.2]	7.9	[6.8-9.0]
Poverty	27.4	[25.5, 29.4]	20.1	[18.5, 21.8]
Parental substance abuse	9.1	[8.0, 10.4]	8.9	[7.8-10.2]
Physical abuse	8.4	[7.3, 9.7]	6.5	[5.7, 7.5]
Sexual abuse	5.6	[4.7, 6.6]	7.2	[6.3, 8.2]

As very few participants were exposed to more than two ACEs, three categories were created reflecting the experience of 'None', 'One' or 'Two or more' ACEs. Table 5.3 demonstrates the distribution of BMI classification for each ACE in men and women, while Figure 5.4 illustrates the prevalence of cumulative ACEs by BMI classification and sex. The prevalence of overweight and obesity is not associated with experience of adverse childhood events, whether individually or cumulatively. A similar lack of association is apparent between WC and ACEs (Appendix Table A7 & Figure A8).

Table 5.3. Distribution of body mass index by adverse childhood events and sex

		Men % [95% CIs]			Women % [95% CIs]		
		Normal	Overweight	Obese	Normal	Overweight	Obese
Fair or poor health	***Yes***	21 [15, 29]	41 [33, 49]	38 [30, 46]	31 [25, 38]	38 [31, 45]	31 [25, 38]
	No	16 [14, 17]	46 [44, 48]	38 [36, 40]	26 [24, 28]	40 [38, 42]	34 [32, 36]
Poverty	***Yes***	17 [14, 20]	43 [39, 47]	40 [36, 44]	25 [21, 29]	39 [34, 43]	37 [32, 41]
	No	16 [14, 17]	47 [45, 49]	38 [35, 40]	27 [25, 29]	41 [39, 43]	33 [31, 35]
Parental substance abuse	***Yes***	22 [17, 28]	42 [35, 50]	36 [29, 43]	27 [22, 33]	44 [37, 50]	29 [24, 36]
	No	15 [13, 16]	47 [44, 49]	39 [37, 41]	26 [24, 28]	41 [39, 43]	33 [31, 35]
Physical abuse	***Yes***	14 [10, 20]	45 [38, 53]	41 [33, 48]	21 [16, 28]	43 [36, 50]	36 [29, 43]
	No	15 [14, 17]	46 [44, 49]	38 [36, 40]	26 [25, 28]	41 [39, 43]	33 [31, 35]
Sexual abuse	***Yes***	15 [10, 21]	52 [44, 60]	33 [37, 41]	27 [22, 34)	41 [34, 48]	32 [25, 39]
	No	15 [14, 17]	46 [44, 48]	39 [37, 41]	26 [24, 28]	41 [39, 43]	33 [31, 35]

Figure 5.4. Distribution of body mass index by number of adverse childhood events and sex



Note. N = 5110; Missing obs = 746; Error bars correspond to 95% confidence intervals

5.3 Discussion

International evidence suggests a strong negative gradient between higher SES in childhood and obesity in adulthood (43). However, there are limited associations evident between obesity and childhood circumstances in older Irish adults. Women whose fathers were farmers have the lowest prevalence of obesity; however this is significant only when compared to those whose fathers worked in semi-skilled or non-skilled jobs. Father's educational attainment is negatively associated with obesity in men and central obesity in both men and women. Analysis of transitions in SES across the life course may provide more understanding of the interaction with obesity.

The lack of association between obesity and adverse childhood events conflicts with international evidence which suggests a graded association between exposure to adverse experiences in childhood and obesity in adulthood (46). Issues such as poor recall or reluctance to report adverse events such as abuse may in part explain this lack of relationship in older Irish adults. Information regarding the timing, intensity and duration of adverse childhood experiences are not currently collected in TILDA and may be an area of interest for future research.

6 Obesity and Cardiovascular Health

Cardiovascular disease (CVD) is the leading cause of death in Ireland (47). Obesity is recognised as an independent risk factor for CVD and is also strongly associated with other major CVD risk factors such as hypertension, high cholesterol and insulin resistance (48). It is estimated that for every 5kg/m^2 increase in BMI above 25kg/m^2, CVD mortality increases by 40% (49). Similarly, it has been found that a 1cm increase in WC is associated with a 2% increased risk of developing new CVD (50). Though the mechanisms behind these associations have not been fully elucidated, it is known that excess body fat directly impacts on insulin resistance, thus increasing the risk of type-2 diabetes (49). Excess fat in the abdominal area may directly affect how fats are broken down and transported in the body, leading to high cholesterol (51). As WC has been shown to be a slightly better discriminator of CVD risk factors than BMI (52), it is thus the main focus of this section, which documents the associations between obesity, CVD, CVD risk factors and use of associated medications in older Irish adults.

6.1 Cardiovascular Disease

In TILDA, details of doctor-diagnosed CVD and CVD risk factors are recorded during the CAPI. The following conditions are considered CVD: angina, heart attack, heart failure, stroke, transient ischemic attack (TIA, also referred to as a mini-stroke) or a heart murmur. The prevalence of doctor-diagnosed CVD is 17.3% in older Irish men and 14.1% in women (data not shown). Table 6.1 indicates the prevalence of doctor-diagnosed CVD according to WC classification in men and women. A higher proportion of centrally obese men and women report a doctor's diagnosis of at least one CVD compared to those with a 'normal' or 'increased' WC. In men, those with 'substantially increased' WC have a higher prevalence of heart attacks compared to those with an 'increased' but not a 'normal' WC, while in women this is true for angina and heart failure. Similar associations are noted between CVD and BMI, though the only significant association is for an increased prevalence of any CVD in obese compared to normal weight women (Appendix Table A9).

Table 6.1. Prevalence of cardiovascular disease by waist circumference classification and sex

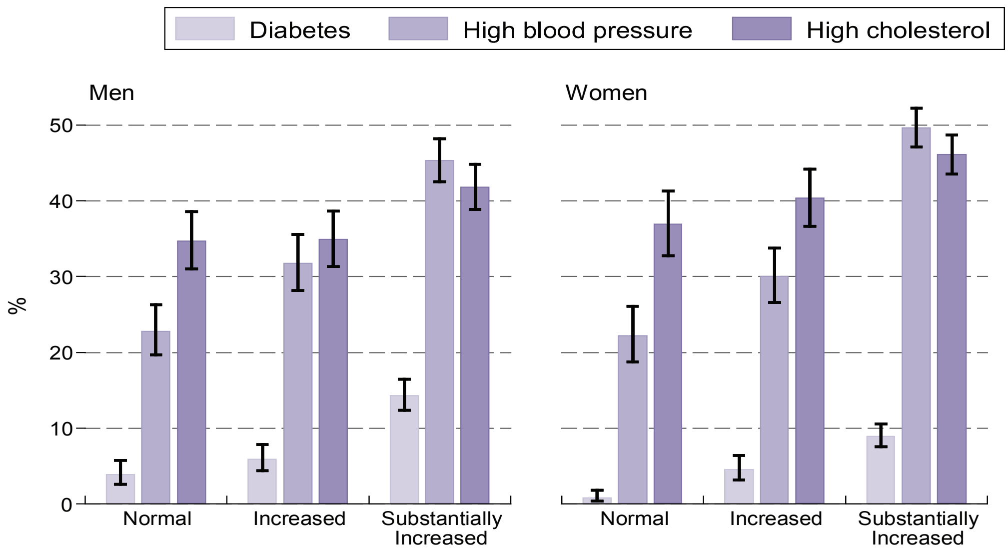
	Men % [95% CIs]			Women % [95% CIs]		
	Normal	Increased	Substantially Increased	Normal	Increased	Substantially Increased
Any Cardiovascular Disease	**14.2** **[11.6, 17.2]**	**13.7** **[11.3, 16.5]**	**21.0** **[18.8, 23.4]**	**10.8** **[8.3, 13.9]**	**11.1** **[8.9, 13.8]**	**16.6** **[14.6, 18.8]**
Angina	5.5 [3.9, 7.6]	6.7 [5.0, 9.0]	8.2 [6.8, 10.0]	3.4 [2.0, 5.7]	2.3 [1.4, 3.7]	6.5 [5.1, 8.2]
Heart Attack	6.6 [4.9, 8.9]	5.5 [4.0, 7.4]	9.5 [7.9, 11.4]	1.9 [0.9, 3.8]	2.4 [1.4, 4.0]	2.8 [2.0, 3.9]
Heart Failure	1.0 [0.4, 2.2]	1.1 [0.5, 2.5]	2.0 [1.3, 3.1]	0.4 [0.1, 2.6)	0.1 [0.0, 0.5]	1.1 [0.7, 1.8]
Stroke	1.5 [0.8, 2.7]	1.4 [0.7, 3.0]	2.3 [1.5, 3.4]	0.7 [0.2, 2.3]	1.3 [0.7, 2.4]	2.2 [1.5, 3.2]
Transient Ischemic Attack	2.6 [1.6, 4.4]	0.8 [0.4, 2.0]	2.8 [2.0, 3.9]	1.6 [0.8, 3.5]	2.5 [1.5, 4.2]	2.1 [1.5, 3.0]
Heart Murmur	3.1 [2.0, 4.8]	3.4 [2.3, 5.0]	4.8 [3.8, 6.2]	5.3 [3.7, 7.6]	5.6 [4.2, 7.5]	5.7 [4.6, 7.1]

6.2 Cardiovascular Disease Risk Factors

6.2.1 Self-reported risk factor prevalence

Doctor-diagnosed high blood pressure, diabetes and high cholesterol, known CVD risk factors, are all associated with central obesity in older Irish men and women (Figure 6.1). In the overall over 50s population, 47.7% of those classified as centrally obese report a doctor's diagnosis of high blood pressure compared to 22.2% of those with a normal WC. Corresponding figures for diabetes are 11.3% vs. 2.5% and for high cholesterol are 44.2% vs. 35.7% (data not shown). Similar, though weaker, associations are noted for BMI (Appendix Figure A10).

Figure 6.1. Prevalence of doctor-diagnosed cardiovascular disease risk factors by waist circumference classification and sex



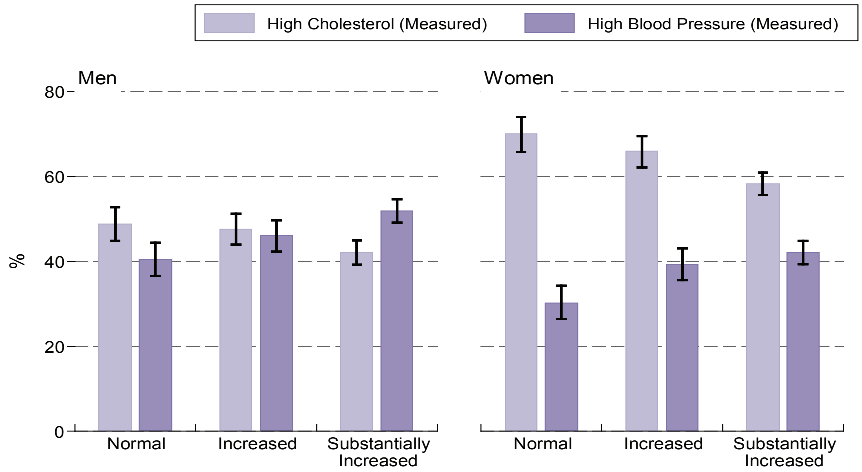
Note. N = 5856; Missing obs = 0; Error bars correspond to 95% confidence intervals

6.2.2 Self-reported vs. Objective High Cholesterol and High Blood Pressure

In addition to self-reported doctor's diagnosis, objective measures of cholesterol and blood pressure were also recorded for those who participated in a health assessment at Wave 1.[3] Figure 6.2 illustrates the prevalence of objectively measured high cholesterol and high blood pressure (also referred to as hypertension) by WC and sex. Compared to those with a 'normal' or 'increased' WC, a lower proportion of centrally obese women has objective evidence of high cholesterol, with no associations apparent in men. A higher proportion of centrally obese men and women have an objective measurement of hypertension compared to those with a normal WC. Similar associations are noted between objectively measured cholesterol and BMI in women; a smaller proportion of obese have objective evidence of cholesterol compared to those classified as normal or overweight (Appendix Figure A11).

3 Further analysis of Wave 1 blood samples is currently underway to determine the prevalence of undiagnosed diabetes in this population.

Figure 6.2. Prevalence of objectively measured high cholesterol and high blood pressure by waist circumference classification and sex



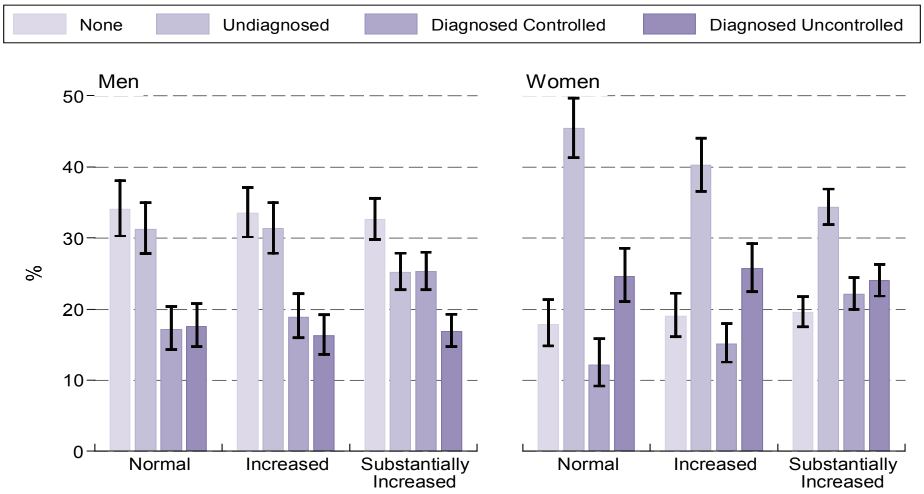
Note. N = 5575; Missing obs = 281; Error bars correspond to 95% confidence intervals

Using the objective and self-reported measurements, four groups of interest were identified for each condition as follows:

1. 'None' – No evidence of the condition using either self-report or objective measurement
2. 'Undiagnosed' – Persons reporting no doctor's diagnosis but with objective evidence of the condition
3. 'Diagnosed Controlled' – Persons reporting a doctor's diagnosis of the condition and with normal objective measurement
4. 'Diagnosed Uncontrolled' - Persons reporting a doctor's diagnosis who also have objective evidence of the condition

Figure 6.3 illustrates the different cholesterol profiles according to these criteria in men and women, and their relationship to WC classification. Compared to those with a 'normal' WC, a lower proportion of centrally obese men and women have undiagnosed high cholesterol. A higher proportion of centrally obese men and women have objectively measured and controlled high cholesterol than their normal or overweight counterparts. Similar results are noted with BMI (Appendix Figure A12).

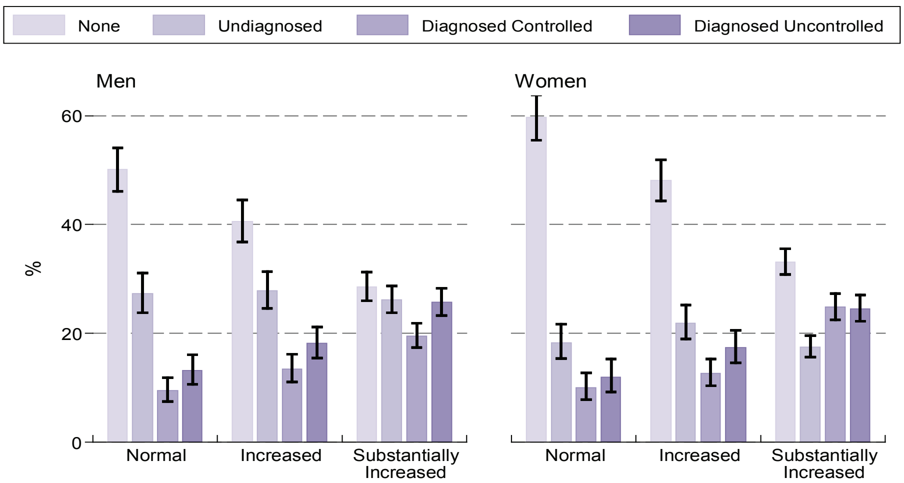
Figure 6.3. Prevalence of diagnosed and undiagnosed high cholesterol by waist circumference classification and sex



Note. N = 5604; Missing obs = 252; Error bars correspond to 95% confidence intervals

Figure 6.4 illustrates the prevalence of diagnosed and undiagnosed high blood pressure by WC and sex. Over twenty per cent of men and women with a ‘substantially increased’ WC have diagnosed, uncontrolled hypertension compared to less than 10% of those with a normal WC. There are no differences in undiagnosed hypertension by WC classification. Similar patterns are observed between objectively measured hypertension and BMI (Appendix Figure A13).

Figure 6.4. Prevalence of diagnosed and undiagnosed high blood pressure by waist circumference classification and sex

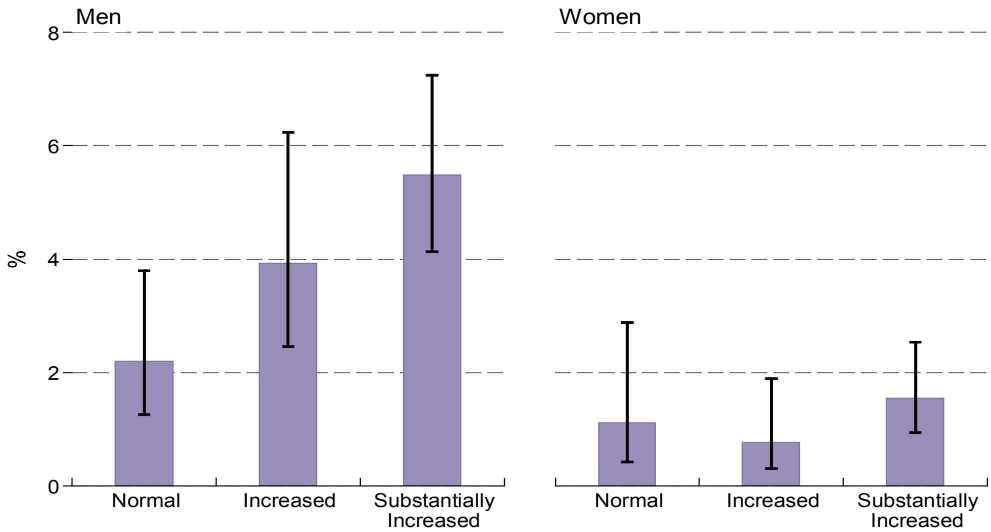


Note. N = 5825; Missing obs = 31; Error bars correspond to 95% confidence intervals

6.2.3 Atrial Fibrillation

Atrial fibrillation is a common cardiac arrhythmia that is a known risk factor for stroke (53). This condition has previously been shown to be under diagnosed in the TILDA cohort - 2.9% of the older population have evidence of atrial fibrillation and over 40% of these are unaware of it (54). Increased BMI has been associated with an increased risk of atrial fibrillation in the general population (55), while both BMI and WC are associated with the condition in older Chinese adults (56). During the Wave 1 health assessment, 4875 TILDA participants had a valid electrocardiogram (ECG) recorded and these were individually analysed for the presence of atrial fibrillation. Figure 6.5 indicates the prevalence of atrial fibrillation in older Irish adults according to WC classification and sex. Over five per cent of men with central obesity have evidence of atrial fibrillation compared to 2.2% of men with a normal WC, while no associations are noted in women. There are no associations evident between atrial fibrillation and BMI in either men or women (Appendix Figure A14).

Figure 6.5. Prevalence of atrial fibrillation by waist circumference classification and sex



Note. N = 4875; Missing obs = 981; Error bars correspond to 95% confidence intervals

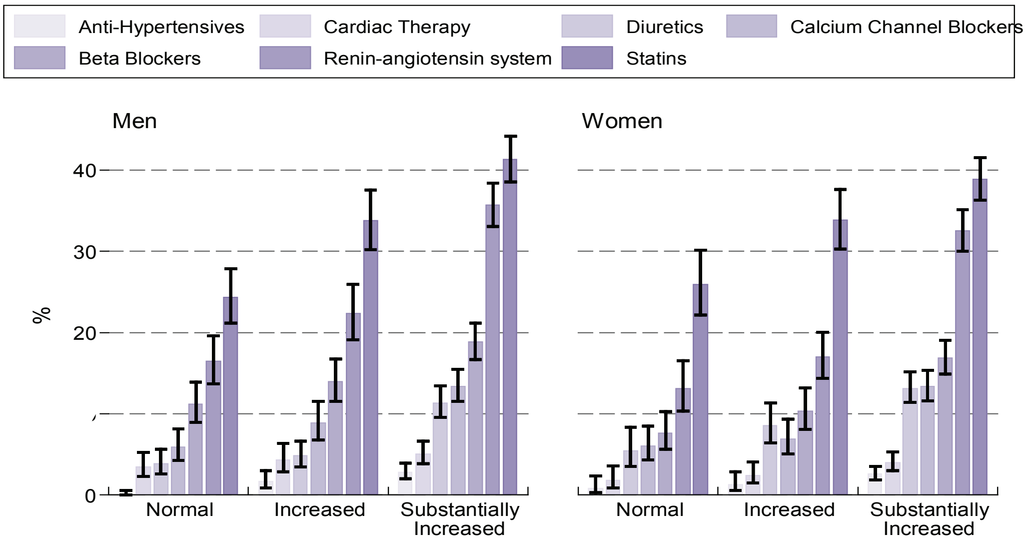
6.3 Cardiovascular Medications

Comprehensive information on participants' medication use is available in TILDA. During the CAPI, participants are asked to record all medications taken on a regular basis, including prescription and non-prescription items. Interviewers then visually inspect medication packages and record the exact name of up to 20 medications. These medications are then classified according to the WHO Anatomic Therapeutic Chemical (ATC) system. ATC codes beginning with “C” refer to the specific subtypes of medications acting on the cardiovascular system (57). Table 6.2 lists the subgroups of cardiovascular medications commonly prescribed among the TILDA sample.

Table 6.2. Anatomic Therapeutic Chemical subtypes of medications acting on the cardiovascular system

ATC Code	Description
C01	Cardiac Therapy
C02	Antihypertensives
C03	Diuretics
C07	Beta Blocking Agents
C08	Calcium Channel Blockers
C09	Agents acting on the Renin-Angiotensin System
C10	Lipid Modifying Agents (Statins)

Figure 6.6. Prevalence of prescribed cardiovascular medication use by waist circumference classification and sex



Note. N = 5856; Missing obs = 0; Error bars correspond to 95% confidence intervals

Figure 6.6 illustrates the prevalence of prescribed cardiovascular medications in older Irish adults by WC classification and sex. Lipid modifying agents, used for the treatment of high cholesterol, are the most commonly prescribed cardiovascular medications in older Irish adults, taken by 35.1% of the population, followed by medications acting on the renin-angiotensin system, taken by 26.1% of the population (data not shown). With the exception of drugs prescribed as ‘Cardiac Therapy’ and ‘Antihypertensives’, all classes of cardiovascular medications are more commonly prescribed to men and women with a substantially increased WC compared to those with a normal WC. Similar findings are evident with BMI (Appendix Figure A15).

6.4 Discussion

There is a clear link between excess body fat and CVD in older Irish adults, whereby the prevalence of doctor-diagnosed CVD is approximately 1.5 times higher in those with central obesity compared to those with a normal WC. Consistent with other reports, these associations are stronger when assessed using WC than using BMI. However, the cross sectional nature of this data does not allow one to infer causality, and the direction of these associations will only become clear when analysed longitudinally.

CVD risk factors are highly prevalent in those who are obese or centrally obese. For example, doctor-diagnosed hypertension is at least twice as common and doctor-diagnosed diabetes is more than four times as common in those with a substantially increased WC compared to those with a normal WC. In addition, a higher proportion of those with a raised WC or BMI have objectively diagnosed but controlled hypertension and high cholesterol, although rates of objectively diagnosed but uncontrolled hypertension are also higher in those with central obesity. Despite the common use of blood pressure lowering medications, diagnosed hypertension appears poorly controlled in obese older adults. More research is required to investigate the efficacy of current blood pressure lowering treatments in this group. High cholesterol is evidently a problem in all ranges of WC and BMI. This is particularly worrying trend among women, where 45% of those with a ‘Normal’ WC have undiagnosed high cholesterol. These data suggest that older adults with a normal WC or BMI should be screened more routinely for high cholesterol. Atrial fibrillation is more common in centrally obese men than those with a normal WC. While no cross-sectional association is evident between WC and stroke in older Irish adults, international research shows that those with atrial fibrillation are at increased risk of stroke. Further waves of TILDA are required to investigate this association in the Irish context.

Unsurprisingly, a higher proportion of those with a raised WC or BMI are taking prescribed cardiovascular medication. This is true for several subtypes of cardiovascular medications, with the most commonly prescribed medications being those used to treat cholesterol and high blood pressure.

7 Obesity, Health and Physical Function

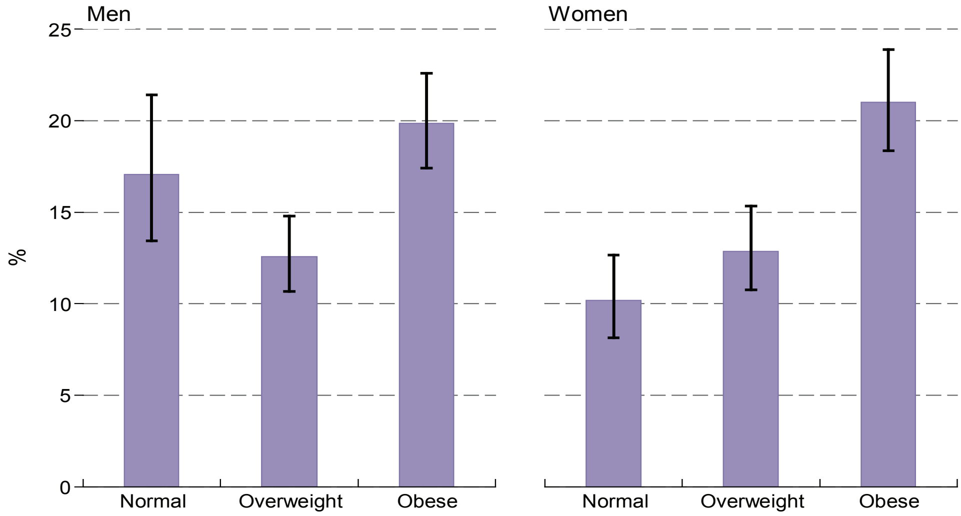
In addition to an increased prevalence of CVD, the ageing process is associated with an increased prevalence of chronic disease, reduced physical function and increased physical disability. However these conditions are exacerbated in the presence of obesity (2). TILDA collects extensive self-reported health data during the CAPI, which includes participants self-rated health, doctor-diagnosed disease and measures of physical limitations and disability. Additional objective measures of physical function were collected during the Wave 1 health assessment. This section outlines the relationships between obesity and self-reported non-cardiovascular health, physical function and disability at TILDA Wave 1.

7.1 Self-rated Health

Self-rated health is considered a valid and reliable indicator of overall health status and has been shown to be a strong predictor of survival in older adults (58); it is also negatively associated with obesity in other populations (59). During the CAPI interview, TILDA participants were asked to rate their health relative to other people of the same age using the following classification; 'excellent', 'very good', 'good', 'fair' or 'poor'. Responses were categorised into two groups: 1. 'excellent', 'very good' or 'good', and 2. 'fair' or 'poor'.

Twenty one per cent of obese women rate their health as 'fair' or 'poor' compared to just 10.2% of women with a normal BMI and 12.9% of those classified as overweight (Figure 7.1). In men, there is no difference in self-rated health between those classified as normal (17%) and those classified as obese (19.9%) with just 12.6% of overweight men rating their health as 'fair' or 'poor'. Similar association are noted between self-rated heath and WC in women, while a greater proportion of obese men report their health as 'fair' or 'poor' compared to those with a normal or increased WC (Appendix Figure A16).

Figure 7.1. Proportion of TILDA participants rating their health as 'fair' or 'poor' by body mass index classification and sex

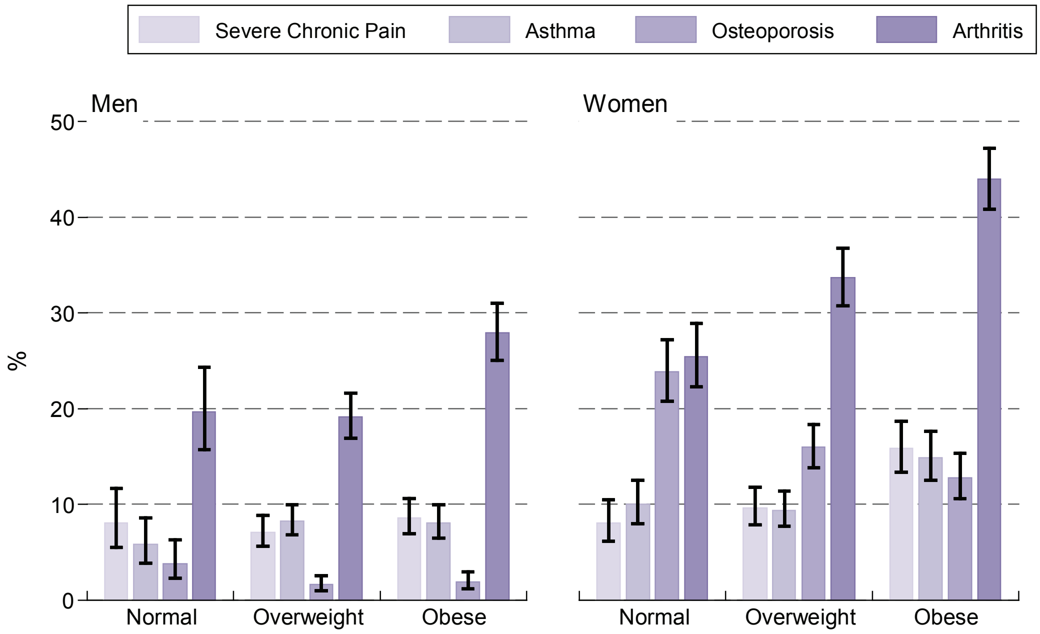


Note. N = 5814; Missing obs = 42; Error bars correspond to 95% confidence intervals

7.2 Chronic Health Conditions

Chronic health conditions such as musculoskeletal disorders, respiratory problems and cancer are common among older Irish adults (60), with 79% reporting at least one doctor-diagnosed chronic disease or CVD at Wave 1. However, certain conditions are more frequently diagnosed in obese persons. Figure 7.2 demonstrates the prevalence of various non-CVD chronic conditions by BMI classification and sex. Arthritis is the most commonly diagnosed chronic condition among older Irish adults affecting 21% of men and 33.7% of women (60). The prevalence of arthritis is 44% in obese women compared to 25.4% in those with a normal BMI. Corresponding figures for men are 27.9% vs. 19.7%. Obesity is positively associated with asthma and chronic pain in women but not men, while there is a negative relationship between BMI and diagnosed osteoporosis in women. Similar associations are noted with WC (Appendix Figure A17).

Figure 7.2. Prevalence of chronic health conditions by body mass index classification and sex



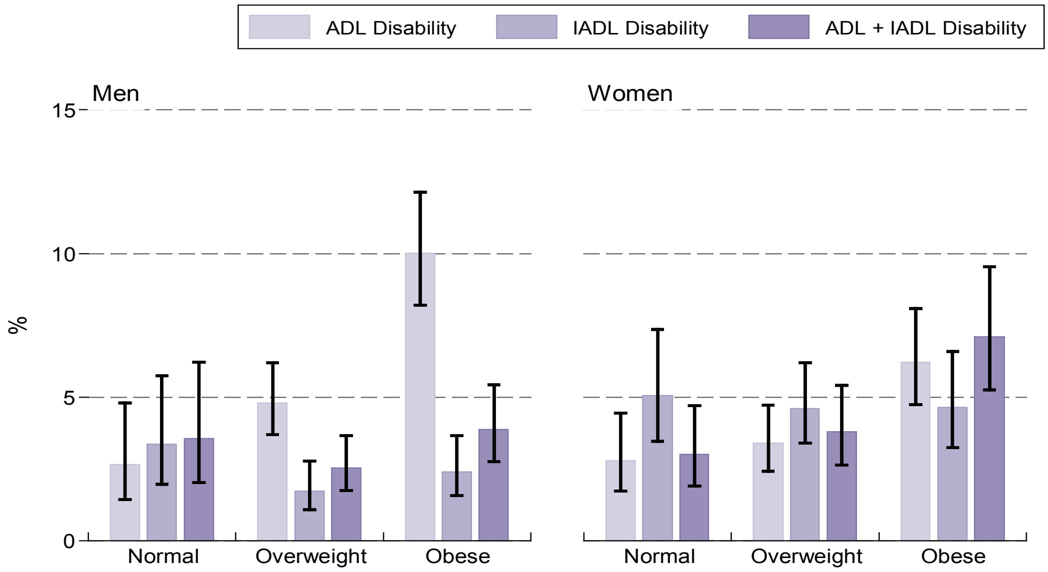
Note. N = 5818; Missing obs = 38; Error bars correspond to 95% confidence intervals

7.3 Physical Disability

Disability is defined in TILDA as having difficulty because of a health or memory problem, carrying out activities of daily living (ADLs) and instrumental activities of daily living (IADLs). ADLs refer to essential daily activities such as dressing, showering, toileting and eating. IADLs describe activities such as shopping, taking medications, managing money and preparing a hot meal, which though not essential to daily life, are important in the context of maintaining one's independence in older age.

In total, 11% of men and 14% of women reported having at least one ADL and/or IADL disability at TILDA Wave 1 (60). Figure 7.3 illustrates the prevalence of ADL, IADL and combined ADL/IADL disability by BMI classification in men and women. In men, there is no association between BMI and IADL or combined ADL/IADL disability. However, 10% of obese men report an ADL disability compared to 3% of men with a normal BMI. The prevalence of both ADL disability and combined ADL/IADL disability is higher in obese women compared to their normal weight counterparts. Compared to those with a normal WC, central obesity is associated with an increased prevalence of ADL disability in men and combined ADL and IADL disability in women (Appendix Figure A18).

Figure 7.3. Prevalence of ADL and IADL disability by body mass index classification and sex



Note. N = 5824; Missing obs = 32; Error bars correspond to 95% confidence intervals

7.4 Physical Function

Obesity has been shown to worsen the age-related decline in physical function (61), and is associated with an increased prevalence of frailty in older adults in TILDA and other ageing studies (62-64). Further, when obesity is combined with low muscle mass or strength, the impact on disability and function is greater (65, 66).

The TILDA health assessment includes the following objective measures of physical function:

- **Grip strength**, assessed in kilograms using a hand-held dynamometer
- **Gait speed**, measured in centimetres per second over a 4.88 metre walk on a computerised walkway
- **Timed up and go (TUG)**, assessed in seconds by asking participants to rise from a chair, walk 3m at normal pace to a line clearly marked on the floor, turn around, walk back to the chair, and sit down again

Both grip strength and gait speed have been shown to predict future adverse outcomes including disability and mortality (67, 68). Table 7.1 outlines mean grip strength, gait speed and TUG time by BMI classification in men and women. Mean grip strength is greater in obese compared to normal weight men while both gait speed and TUG are slower in obese men compared to both the normal and overweight groups. In women, grip strength is not associated with BMI; both gait speed and TUG are slowest in obese women, and the discrepancy between BMI groups is greater than that noted in men. A similar relationship is noted between WC, gait speed and TUG, but no association is evident with grip strength in either men or women (Appendix Table A19).

Table 7.1. Performance on measures of physical function by body mass index classification and sex

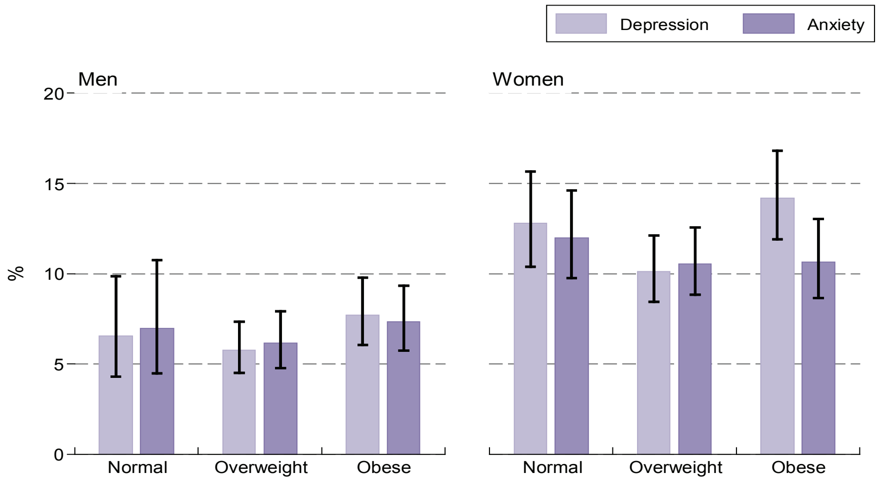
	Normal Mean [95% CIs]	Overweight Mean [95% CIs]	Obese Mean [95% CIs]
	Men		
Grip Strength (kg)	32.1 [31.2, 33.1]	33.6 [33.0, 34.1]	33.8 [33.8, 34.4]
Gait Speed (cm/s)	140.5 [138.1, 142.8]	138.7 [137.3, 140.0]	134.3 [132.8, 135.8]
Timed Up and Go (s)	9.1 [8.8, 9.4]	9.1 [8.8, 9.4]	9.6 [9.4, 9.9]
	Women		
Grip Strength (kg)	19.1 [18.7, 19.5]	19.2 [18.9, 19.6]	19.0 [18.5, 19.4]
Gait Speed (cm/s)	137.2 [135.3, 139.0]	134.2 [132.7, 135.7]	125.7 [124.1, 127.3]
Timed Up and Go (s)	9.1 [8.8, 9.4]	9.3 [9.0, 9.6]	10.7 [10.1, 11.3]

7.5 Mental Health

Obesity, measured either by BMI or WC has been associated with an increased likelihood of reporting depressive symptoms (69, 70), while there is conflicting evidence for both positive and negative associations between BMI, WC and anxiety (71, 72). High rates of undiagnosed, case level symptoms of depression and anxiety have previously been highlighted in the TILDA sample (60). Depression is assessed in TILDA using the 20 item Centre for Epidemiological Studies Depression (CESD) scale (73) and anxiety is assessed using the seven item anxiety subscale of the Hospital Anxiety and Depression Scale (HADS) (74).

Figure 7.4 indicates the prevalence of clinically significant anxiety and depression by BMI classification in men and women. There are no associations between BMI and mental health in men or women. Similarly, no associations are evident between WC classification and mental health in either men or women (Appendix Figure A20).

Figure 7.4. Prevalence of clinically significant symptoms of anxiety and depression by body mass index classification and sex



Note. N = 5084; Missing obs = 772; Error bars correspond to 95% confidence intervals

7.6 Discussion

There is a clear association between total and central obesity, chronic disease and physical function in older Irish adults. The cross-sectional nature of this analysis does not allow us to infer causality and there are a number of possible scenarios linking obesity, disease and physical function. For example, the development of arthritis may precede chronic pain and restricted movement, in turn leading to reduced physical function indicated, for example, by decreased gait speed. This may then cause activity restriction and thus weight gain. Conversely, obesity may hasten the development of arthritis due, for example, to increased joint loading. Subsequent pain and activity restriction may exacerbate weight gain, feeding into a cycle of weight gain – inactivity – weight gain.

Previous research has indicated an increased obesity-associated health burden in women compared to men (75, 76). While this is evident in the TILDA sample in relation to chronic disease and objective measures of physical function, the opposite is true for ADL disability where 10% of obese men report a disability compared to 6% of obese women. Further waves of TILDA will facilitate the study of changes in weight and BMI status over time, and help to establish the direction of the relationships between obesity, disease and physical function.

In contrast to previous international studies, no cross sectional associations are evident between obesity and mental health in older Irish adults.

8 Obesity and Health Behaviours

The modernisation of society in recent times is associated with a decrease in habitual physical activity, an increase in sedentary behaviour and the increased availability of high-fat, energy dense foods, all of which have been implicated in the rapid rise in obesity prevalence (1). Previous research indicates that energy intake does not increase with ageing, therefore changes in energy balance and thus body weight in older adults are mainly due to decreased physical activity (2). Health behaviours, namely physical activity habits, smoking habits and alcohol consumption are also hypothesised to explain, at least in part, the link between SES and obesity (77). TILDA collects self-reported information on physical activity levels, past and current smoking behaviours and alcohol consumption. This section describes the relationship between BMI, WC and health behaviours in older Irish adults.

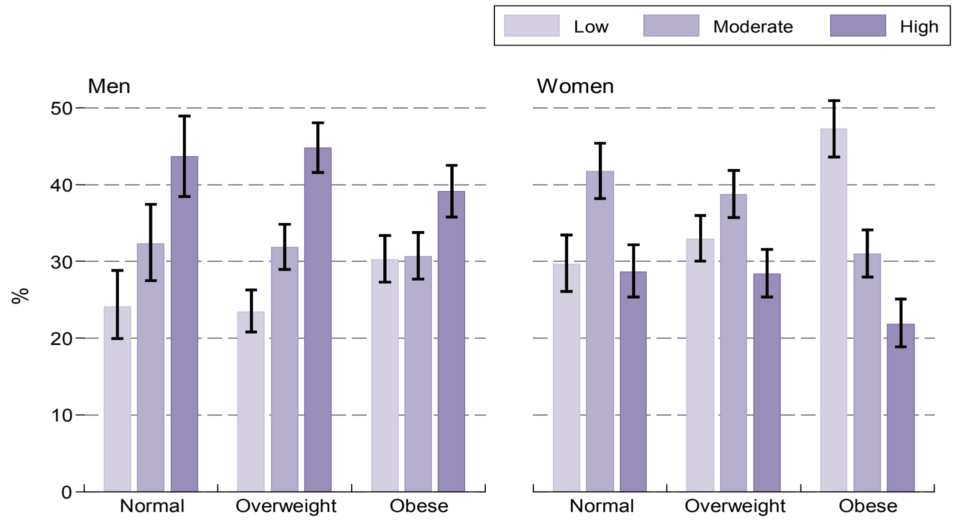
8.1 Physical Activity

Physical activity is assessed in TILDA using the International Physical Activity Questionnaire (IPAQ), which classifies participants into ‘low’, ‘moderate’ or ‘high’ levels of physical activity. Almost half of obese women (47%) are classified as ‘low’, indicating that they do not meet the recommended levels of physical activity, compared to 33% of overweight women and 30% of normal weight women (Figure 8.1). There is no difference in physical activity between obese and normal weight men (although a higher proportion of obese men report low levels of physical activity than their overweight counterparts). However 30% of centrally obese men report low levels of physical activity compared to 22% of those with a normal or increased WC (Appendix Figure A21).

8.2 Smoking

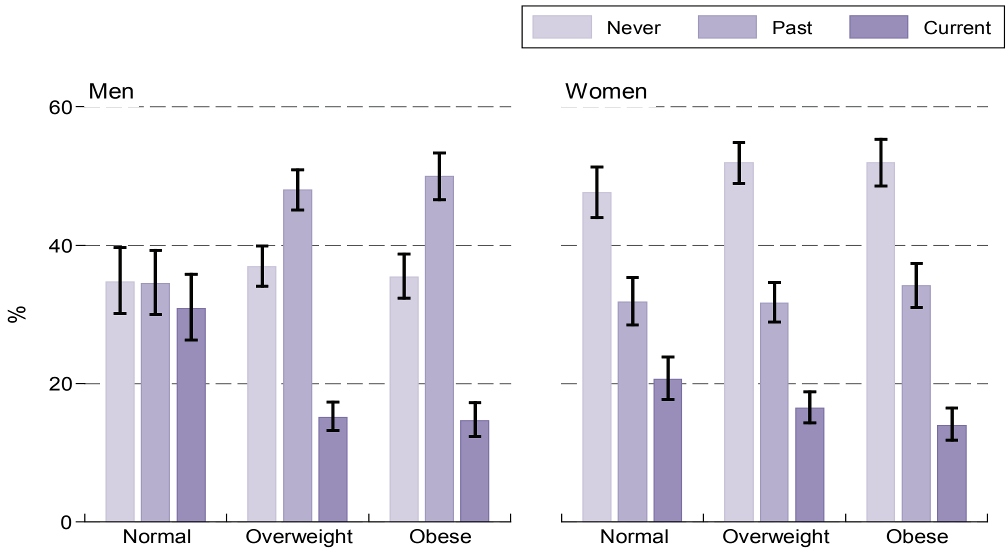
In comparison to men who have a normal BMI, a lower proportion of men who are overweight or obese are current smokers and a higher proportion are past smokers (Figure 8.2). A lower proportion of obese women are also current smokers, although no association is apparent between BMI classification and past smoking for women. A similar relationship is evident between WC and smoking behaviour (Appendix Figure A22).

Figure 8.1. IPAQ physical activity level classification by body mass index classification and sex



Note. N = 5775; Missing obs = 81; Error bars correspond to 95% confidence intervals

Figure 8.2. Smoking status by body mass index classification and sex

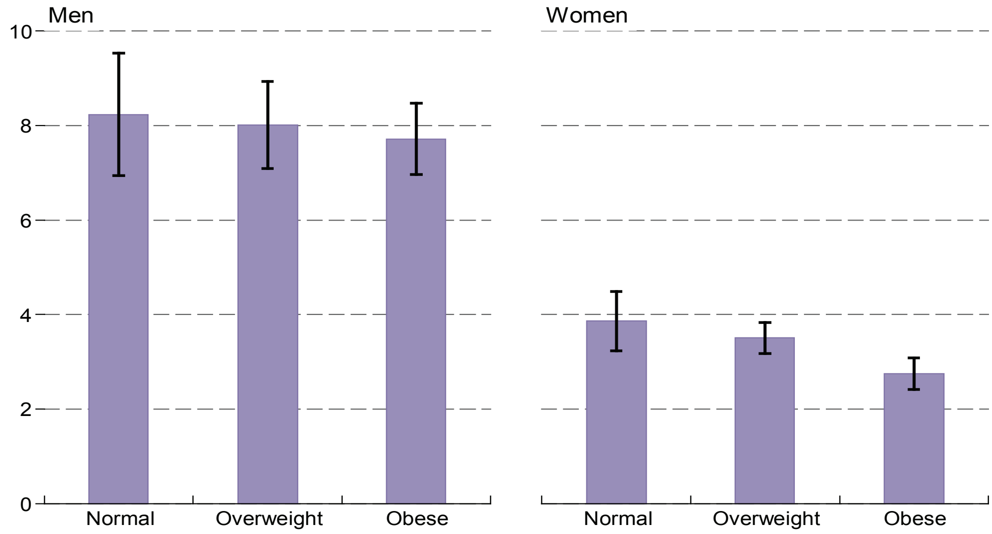


Note. N = 5824; Missing obs = 32; Error bars correspond to 95% confidence intervals

8.3 Alcohol

The frequency and volume of alcohol consumption is assessed in TILDA Wave 1 through a series of questions contained in the self-completion questionnaire. Figure 8.3 illustrates the average number of alcoholic drinks consumed per week by BMI classification and sex. There is no association between weekly alcohol consumption and BMI classification in men; however, obese women consume fewer standard units per week than normal or overweight women. There is no association between WC and the average number of alcoholic drinks consumed per week in either men or women (Appendix Figure A23).

Figure 8.3. Average number of standard alcohol units consumed weekly by body mass classification and sex



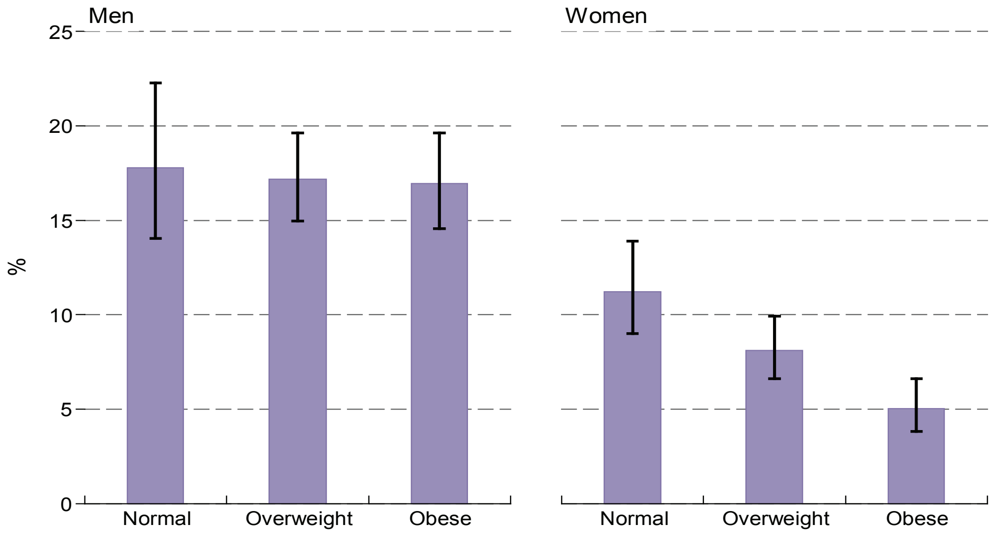
Note. N = 4988; Missing obs = 868; Error bars correspond to 95% confidence intervals

'Problem drinking' is further assessed in TILDA using the CAGE score. CAGE is an acronym for '**C**ut-**A**nnoyed-**G**uilty-**E**ye opener' and its use has been validated and widely implemented in clinical practice (78). The CAGE score is derived from responses to the following four questions, with problem drinking defined as a positive response to two or more of the items:

- Have you ever felt that you should cut down on drinking?
- Have people ever annoyed you by criticising your drinking?
- Have you ever felt bad or guilty about your drinking?
- Have you ever taken a drink first thing in the morning to steady your nerves or get rid of a hangover?

The prevalence of problematic drinking by BMI classification and sex is shown in Figure 8.4. There is no relationship between problematic drinking and BMI in men. A lower proportion of obese women (5%) report symptoms of problematic drinking compared to normal (11%) or overweight women (8%). There are no associations between WC and problematic drinking in either men or women (Appendix Figure A24).

Figure 8.4. Prevalence of problematic alcohol consumption by body mass index classification and sex



Note. N = 5207; Missing obs = 649; Error bars correspond to 95% confidence intervals

8.4 Discussion

Obesity and central obesity are associated with low physical activity levels in older Irish adults, with obese women affected to a greater extent than men. Section 7 of this report highlights an increased prevalence of joint replacements, arthritis and asthma in obese women, with a lesser association noted in men. These conditions are potential barriers to physical activity due to associated pain and restricted movement, also indicated in obese women in TILDA. As with the relationship between obesity, chronic disease and physical function, longitudinal data will be invaluable in ascertaining the direction of the relationship between obesity and physical activity in older Irish adults. Understanding the barriers to physical activity in this population should also be taken into consideration when designing and implementing weight control programmes.

The association between past smoking and overweight and obesity in older Irish men is supported by international evidence. Smoking is inversely related to body weight due to an increased metabolic rate; smoking cessation is associated with an average weight increase of 2.8kg in men and 3.8kg in women (79). However the benefits of smoking cessation outweigh the consequences of weight gain (80), and weight control methods should be integrated into smoking cessation programs to encourage adherence (1).

Obesity is negatively associated with alcohol consumption and problematic drinking in older Irish women. Conflicting evidence exists regarding the relationship between alcohol and obesity, with some suggestions of a U-shaped relationship – that is, both alcohol abstinence and heavy alcohol consumption may be associated with obesity, while mild to moderate alcohol intake may be protective against weight gain (81).

A key component of obesity-related health behaviour is dietary habits. However information relating to diet was not collected at TILDA Wave 1. TILDA Wave 3 includes a food frequency questionnaire which will add to our understanding of the relationship between obesity and health behaviours in older Irish adults.

9 Obesity and Health Service Utilisation

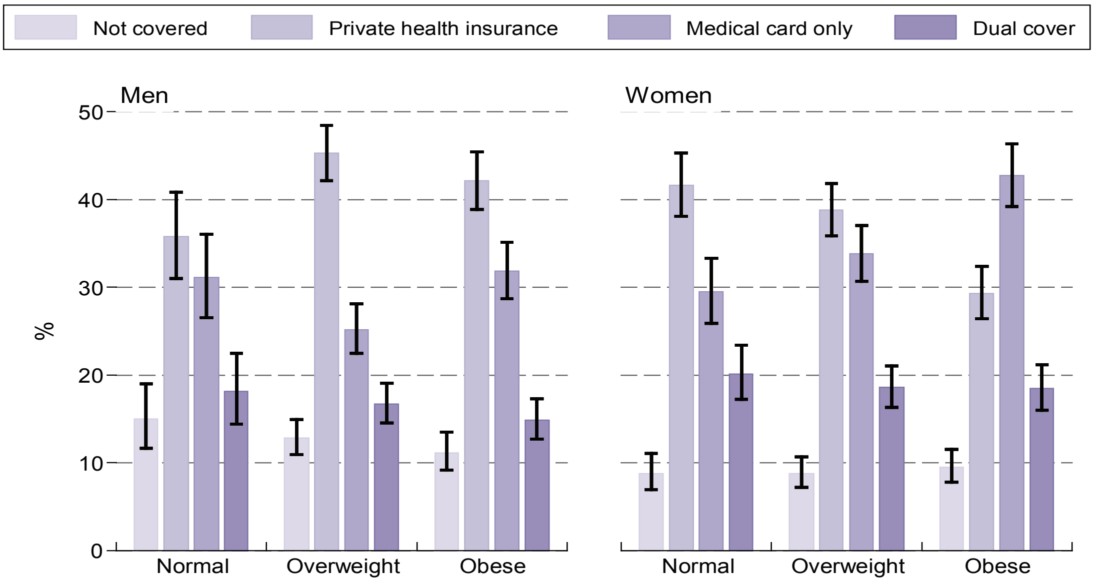
International data suggest that an obese person incurs 25% greater health care expenditure per year than a person of normal weight (82) while the treatment of obesity-related illness accounts for up to 20% of health care spending in the United States (83). Recent estimates suggest that in 2009 the economic cost of obesity in the Republic of Ireland was €1.13billion, accounting for 2.7% of direct health care costs (14). TILDA collects comprehensive information on health service utilisation from all participants, as well as information regarding medication use, entitlement to a medical card and uptake of private health insurance. This section investigates the association between obesity and health service utilisation in older Irish adults.

9.1 Health Care Entitlement Status

Health service utilisation and access to services is influenced by health care entitlement status, i.e., medical card eligibility and/or private health insurance status. In Wave 1 of TILDA, 11% of older Irish adults had no medical card or private health insurance, 37% had private health insurance only, 36% had a medical card only and a further 16% had both private health insurance and a medical card (dual cover) (60).[4] Figure 9.1 indicates the distribution of health care entitlement status according to BMI classification and sex. Forty-three per cent of obese women have a medical card only compared to 34% of overweight women and 29% of normal weight women. Just 29% of obese women have private health insurance only compared to 39% of overweight and 42% of normal weight women. Forty-five per cent of overweight men have private health insurance compared to 36% of their normal weight counterparts, with no differences noted between the obese and normal groups. For women, associations between health care entitlement status and WC are similar to those noted with BMI. A higher proportion of men with a normal WC have neither a medical card nor private health insurance compared to centrally obese men (15% vs. 10%, Appendix Figure A25).

4 Figures for those with a medical card only or dual cover status include those with a GP visit card.

Figure 9.1. Distribution of health care entitlement status by body mass index classification and sex



Note. N = 5820; Missing obs = 36; Error bars correspond to 95% confidence intervals

9.2 Health Service Utilisation

TILDA participants are asked several questions relating to their health service utilisation. This includes the number of times that they have visited a GP in the previous year, and whether or not they have availed of outpatient services, visited a hospital emergency department (ED) or been admitted to hospital as an inpatient in the previous year. Table 9.1 illustrates the use of these health services by BMI classification and sex in older Irish adults.

Obese men and women visit their GP more frequently than their normal or overweight counterparts (mean=4.7 vs. 3.4 visits). Forty-nine per cent of obese women report attending outpatient services in the previous year compared to 42.1% of overweight and 41.6% of normal weight women. There is no association between BMI and ED visits or inpatient hospital admissions. Central obesity is associated with greater number of GP visits in men and women and a greater likelihood of attending outpatient services in men (Appendix Table A26).

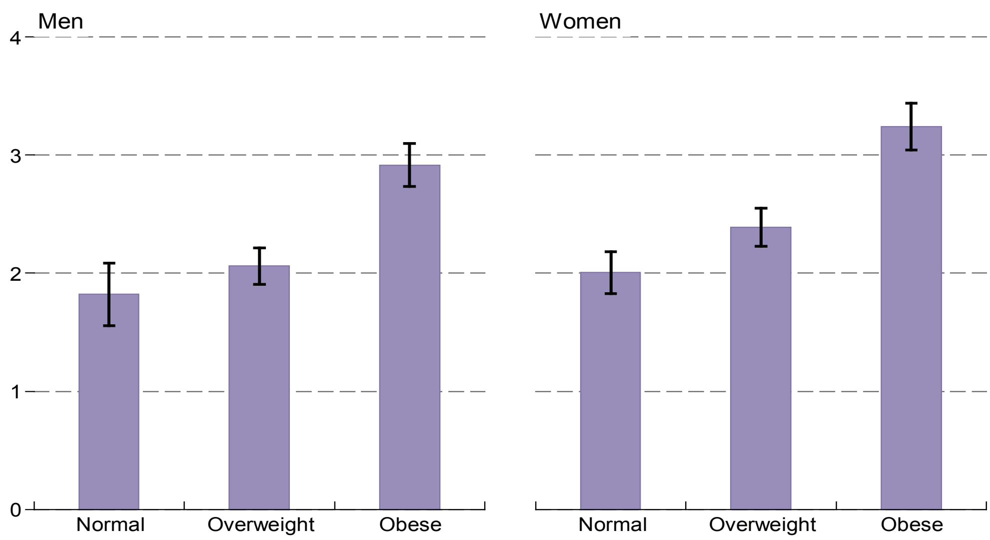
Table 9.1. Health service utilisation in the previous 12 months by body mass index classification and sex

Type of Service	Normal		Overweight		Obese	
Men						
GP visits, Mean [95% CI]	3.2	[2.8-3.7]	3.4	[3.1-3.7]	4.4	[4.0-4.8]
Outpatient visit, % [95% CI]	37.0	[32.2-42.1]	38.7	[35.8-41.7]	44.6	[41.2-48.1]
Emergency Department visit, % [95% CI]	18.1	[14.2,22.7]	14.9	[12.7-17.4]	15.2	[13.1-17.6]
Hospital Admission, % [95% CI]	12.7	[9.4-16.8]	11.7	[9.8-14.0]	14.3	[12.2-16.6]
Women						
GP visits, Mean [95% CI]	3.3	[2.6-4.0]	3.6	[3.3-4.0]	5.0	[4.3-5.7]
Outpatient visits, % [95% CI]	41.6	[37.9-45.3]	42.1	[38.9-45.3]	49.1	[45.6-52.5]
Emergency Department visits, % [95% CI]	16.1	[13.4-19.2]	13.4	[11.3-15.7]	17.0	[14.6-19.8]
Hospital Admission, % [95% CI]	11.5	[9.3-14.1]	11.8	[10.0-14.0]	15.4	[13.1-18.1]

9.3 Medication use

The increased use of specific cardiovascular medications associated with obesity was outlined in Section 6. Considering the additional burden of non-cardiovascular health conditions such as arthritis, asthma and chronic pain in this population, it is likely that the increased use of prescription drugs extends beyond cardiovascular medications.

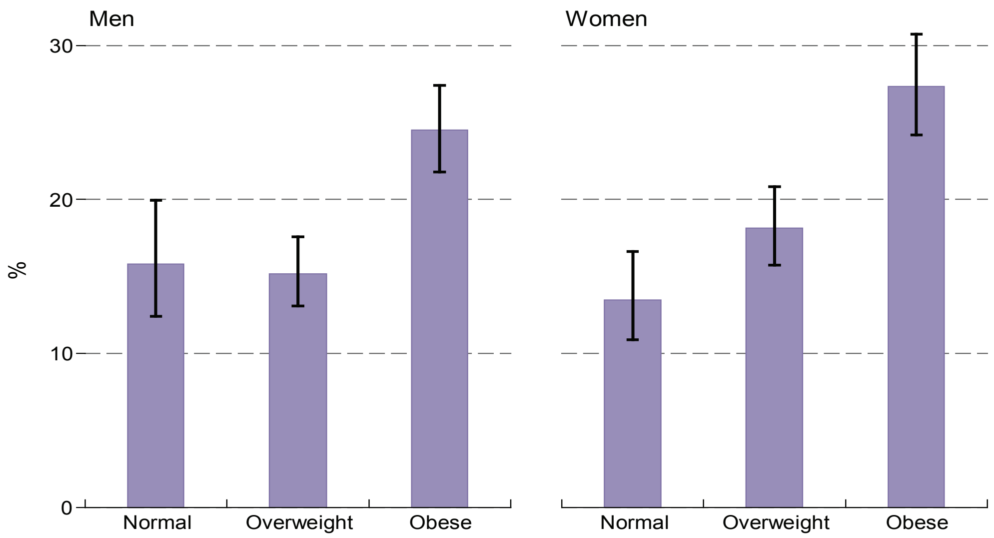
Figure 9.2. Number of prescribed medications by body mass index classification and sex



Note. N = 5789; Missing obs = 67; Error bars correspond to 95% confidence intervals

Figure 9.2 illustrates the mean number of reported prescription medications by BMI classification and sex in older Irish adults. Obese men and women take a greater number of prescribed medications than their overweight or normal weight counterparts. A similar pattern is evident between prescribed medications and WC (Appendix Figure A27).

Figure 9.3. Prevalence of polypharmacy by body mass index classification and sex



Note. N = 5789; Missing obs = 67; Error bars correspond to 95% confidence intervals

Polypharmacy, the concurrent use of five or more medications, is a risk factor for falls, mortality and the development of frailty and disability in older adults (84). High rates of polypharmacy have been previously demonstrated in the TILDA sample and are associated with medical card eligibility, poorer self-rated health and increased morbidity (85). Figure 9.3 demonstrates the prevalence of polypharmacy by BMI classification and sex in older Irish adults. The prevalence of polypharmacy is 24.5% in obese men compared to 15.2% in overweight and 15.8% in normal weight men. Polypharmacy is present in 27.3% of obese women compared to 18.1% of overweight and 13.5% of normal weight women. A similar relationship is evident between polypharmacy and WC (Appendix Figure A28).

9.4 Discussion

Obesity is associated with increased health service utilisation in older Irish adults. The associations presented here between BMI and health service utilisation are consistent with previous findings from SHARE which highlighted increased GP visits, use of outpatient health services and medication use but not hospitalisation in obese older men and women

(86). In that study, BMI was self-reported, and the associations persisted after controlling for several factors including co-morbid disease.

As outlined in Section 6, obese adults have a lower prevalence of undiagnosed high cholesterol and consequently a higher prevalence of diagnosed and controlled high cholesterol. However, a higher proportion of obese individuals have diagnosed but uncontrolled hypertension. A more thorough analysis of obesity and health service utilisation in the TILDA sample has been presented by McHugh et al., (87), and indicates that after adjustment for covariates such as demographic, socio-economic, lifestyle, healthcare entitlement status and chronic illness factors, the significance of obesity in predicting the frequency of GP visits remained. In Ireland, health care entitlement status is correlated with SES (88), thus explaining the higher proportion of medical cards among obese women observed in the TILDA study.

10 Conclusions

This report focuses on obesity prevalence in a representative sample of older Irish adults and documents the associations between BMI, WC and health, social and economic circumstances. While the use of cross-sectional data from Wave 1 of TILDA means that it is not possible to identify the direction of associations or imply causality in the observed relationships, the findings nonetheless highlight a number of issues with direct relevance for policy and clinical practice.

Obesity and central obesity are highly prevalent in older Irish adults. Using BMI as an indicator of obesity is more common among older Irish men than women and does not diminish with advancing age. Both obesity and central obesity are associated with increased cardiovascular disease, non-cardiovascular chronic disease and impaired physical function. As a consequence of this increased morbidity, obesity is associated with increased health service utilisation, specifically in relation to GP visits and medication use.

The combination of an ageing population and a continually increasing prevalence of obesity create a double burden of disease. As the population ages and an increased proportion of people are obese for a greater length of time, the associated health care burden will increase. Currently, overweight and obesity are estimated to account for 2.7% of direct health care costs in the Republic of Ireland (14). Estimates from the United States, which has one of the highest rates of obesity worldwide, suggest that obesity related illness may account for as much as 20% of the health care budget (83). Rates of obesity in Ireland are projected to rise significantly by 2030 (10), suggesting that the associated economic costs will also increase significantly.

Obesity is one of Ireland’s most pressing public health concerns, affecting people of all ages. Nine years on from the publication of the report of the National Taskforce on Obesity, there is no evidence to suggest that the obesity epidemic has slowed down and many of the report’s recommendations remain unmet (89). Targeted policies and practices aimed at preventing obesity and moderating its effects on health across all stages of the life cycle are crucial. As highlighted in this report, low levels of physical activity are strongly linked to obesity, while diet also plays a significant role in weight control. Awareness campaigns targeted at increasing physical activity in older adults and educating this population about the importance of healthy eating are essential. As the over 50s report visiting their GP an average of four times per year, these health professionals are ideally placed to identify those in need of intervention and to initiate and monitor weight control strategies in this group. Given the sex differences observed in the prevalence and correlates of obesity outlined in this report, alternative treatment strategies may be necessary for men and women.

TILDA Wave 3, currently underway, includes a comprehensive health assessment where participant's height and weight are being re-measured. This will allow the first longitudinal analysis of changes in BMI and WC at a population level and help to identify predictors and consequences of weight change in older Irish adults. Future waves of TILDA will also identify transitions into and out of obesity over time and help to establish the independent effects of ageing, co-morbidities and health behaviours on such change. These longitudinal patterns of obesity prevalence and associated lifestyle factors will be of great interest in the context of the recent economic crisis, as there is some international evidence to suggest that economic recession can improve health behaviours such as smoking, alcohol intake and physical activity (90). Conversely, there is a suggestion that obesity is exacerbated in times of financial stress as people may choose cheaper and thus less healthy food options, while the prohibitive cost of membership at health and sports clubs limits exercise opportunities (91). TILDA is ideally placed to investigate the effects of the various austerity budgets from the period of 2009 onwards on health behaviours and obesity trends in older Irish adults.

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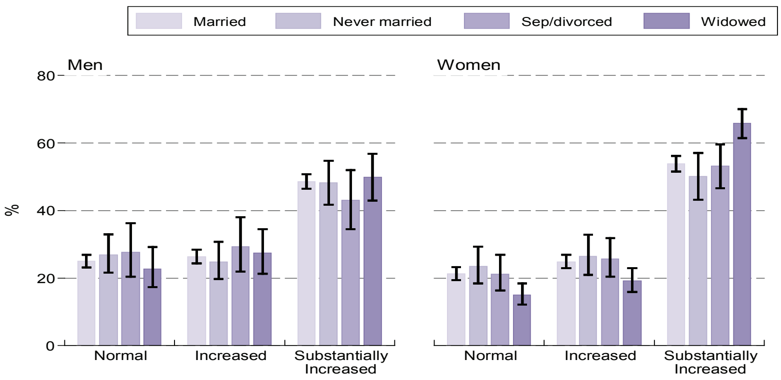
12 Appendix

Figure A1. Distribution of waist circumference by marital status, household composition, household location and sex

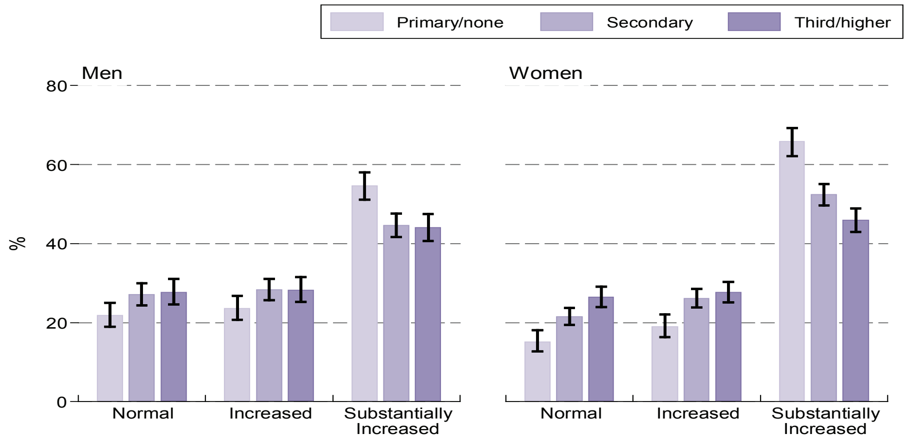


Note. N = 5856; Missing obs = 0; Error bars correspond to 95% confidence intervals

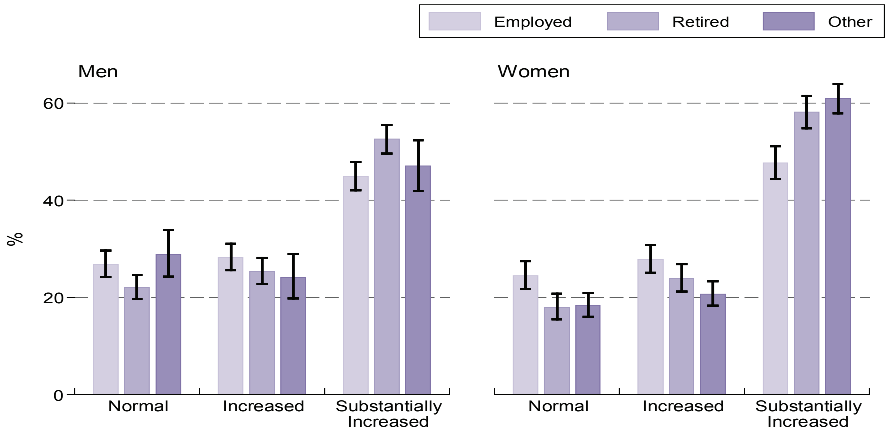
Note. N = 5856; Missing obs = 0; Error bars correspond to 95% confidence intervals

Note. N = 5851; Missing obs = 5; Error bars correspond to 95% confidence intervals

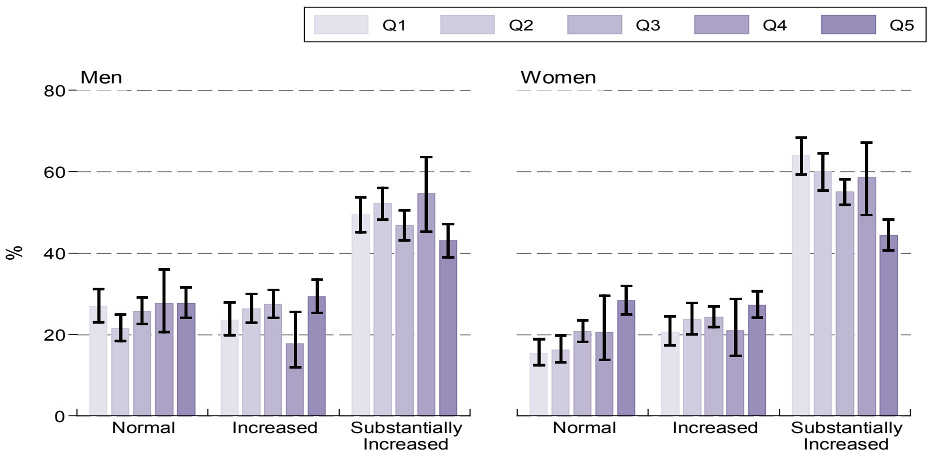
Figure A2. Distribution of waist circumference by educational attainment, employment status, housing wealth and sex



Note. N = 5854; Missing obs = 2; Error bars correspond to 95% confidence intervals



Note. N = 5856; Missing obs = 0; Error bars correspond to 95% confidence intervals



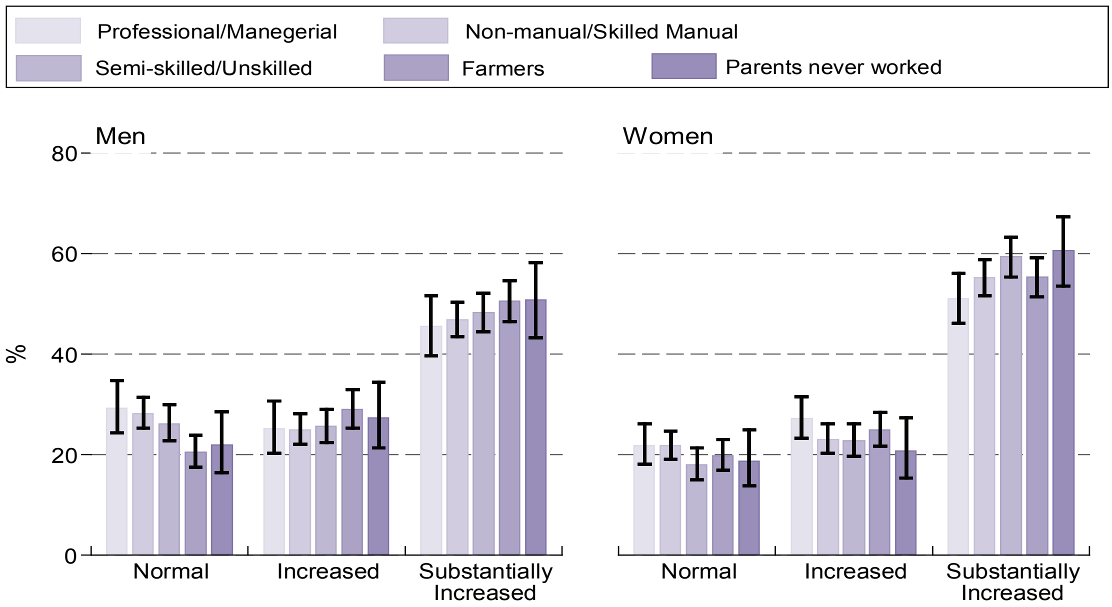
Note. N = 5540; Missing obs = 316; Error bars correspond to 95% confidence intervals

Table A3. Results of logistic regression analysis investigating the association between socioeconomic status and waist circumference classification by sex

	Men Odds Ratio [95% CIs]		**Women** Odds Ratio [95% CIs]	
	Increased	**Substantially Increased**	**Increased**	**Substantially Increased**
Age	1.01 [0.99-1.03]	1.02 [1.00-1.03]	1.01 [0.99-1.03]	1.02 [1.01-1.04]
Education				
Third/Higher	*Ref.*	*Ref.*	*Ref.*	*Ref.*
Secondary	1.03 [0.78-1.37]	1.01 [0.79-1.29]	1.12 [0.88, 1.41]	1.22 [0.98-1.52]
Primary/None	1.02 [0.74-1.40]	1.30 [0.98-1.74]	1.02 [0.72, 1.44]	1.63 [1.20-2.22]
Employment Status				
Employed	*Ref.*	*Ref.*	*Ref.*	*Ref.*
Retired	0.98 [0.71-1.35]	1.04 [0.76-1.43]	1.04 [0.74-1.45]	1.06 [0.77-1.46]
Other	*0.86 [0.62-1.23]*	1.00 [0.75-1.35]	0.90 [0.67, 1.22]	1.15 [0.89-1.50]
Household Housing Wealth				
Highest Quintile	*Ref.*	*Ref.*	*Ref.*	*Ref.*
4^{th}	0.60 [0.34-1.07]	1.22 [0.76-1.96]	1.08 [0.59-1.97]	1.65 [0.99-2.75]
3^{rd}	1.00 [0.73-1.39]	1.12 [0.84-1.49]	1.22 [0.92-1.62]	1.50 [1.15-1.94]
2^{nd}	1.15 [0.81-1.64]	1.42 [1.05-1.92]	1.53 [1.07-2.19]	1.93 [1.39-2.69]
Lowest Quintile	0.84 [0.57-1.22]	1.04 [0.76-1.41]	1.41 [0.98-2.03]	2.11 [1.51-2.95]

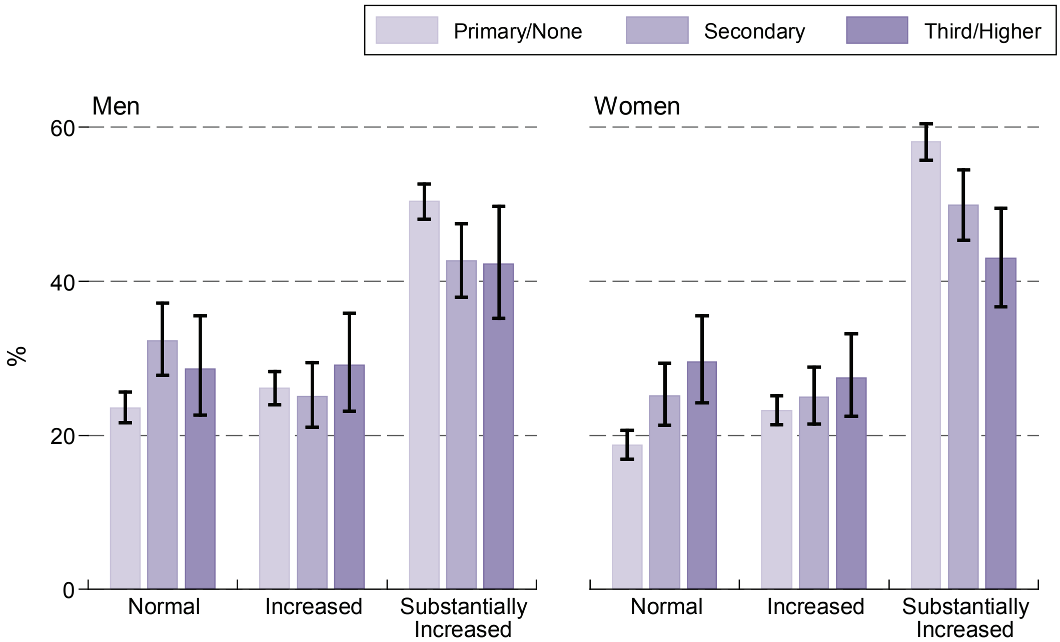
'Normal' WC used as reference category

Figure A4. Distribution of waist circumference by sex and father's social class



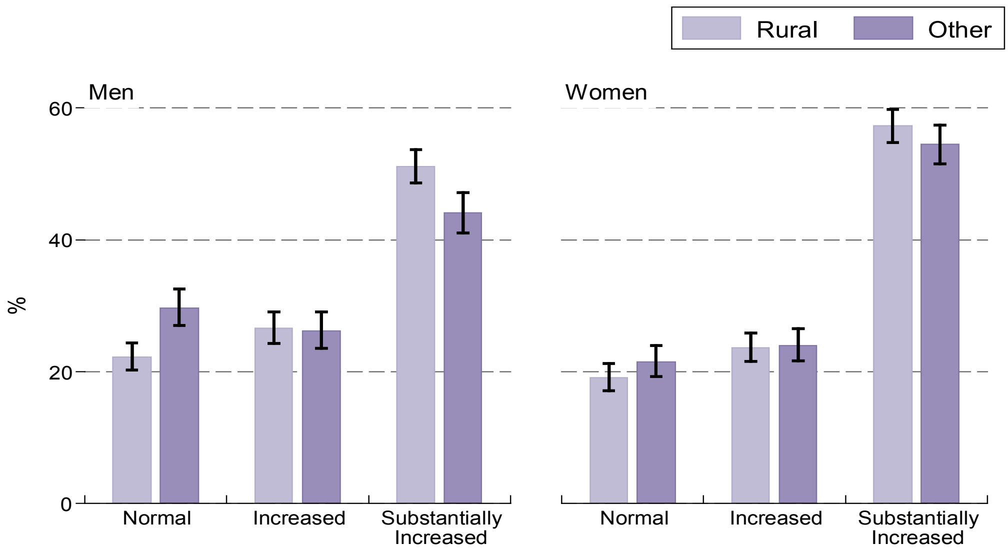
Note. N = 5618; Missing obs = 238; Error bars correspond to 95% confidence intervals

Figure A5. Distribution of waist circumference by sex and father's educational attainment



Note. N = 5374; Missing obs = 482; Error bars correspond to 95% confidence intervals

Figure A6. Distribution of waist circumference by location of upbringing and sex

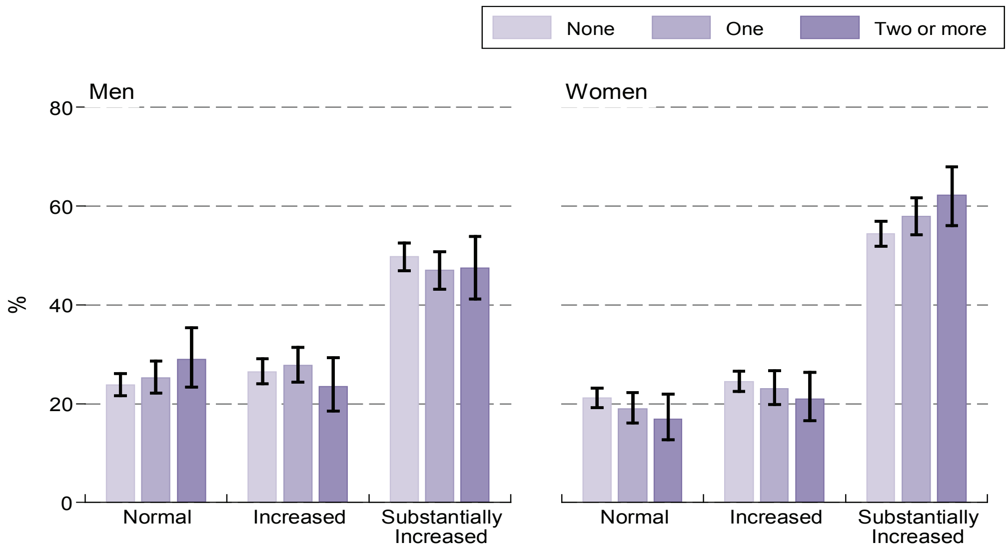


Note. N = 5854; Missing obs = 2; Error bars correspond to 95% confidence intervals

Table A7. Distribution of waist circumference by adverse childhood events and sex

		Men % [95% CIs]			Women % [95% CIs]		
		Normal	Increased	Substantially Increased	Normal	Increased	Substantially Increased
Fair or poor health	***Yes***	28 [21, 36]	23 [17, 31]	48 [46, 50]	23 [18, 29]	20 [15, 26]	57 [50, 63]
	No	25 [23, 27]	27 [25, 29]	48 [46, 50]	20 [18, 21]	24 [23, 26]	56 [54, 58]
Poverty	***Yes***	26 [22, 29]	26 [22, 29]	49 [45, 53]	19 [15, 22]	21 [18, 24]	60 [56, 64]
	No	25 [23, 27]	27 [25, 29]	48 [46, 51]	20 [19, 22]	24 [23, 26]	55 [53, 57]
Parental substance abuse	***Yes***	32 [26, 39]	24 [18, 30]	44 [37, 51]	19 [14, 24]	28 [23, 34]	53 [47, 60]
	No	24 [22, 26]	27 [25, 29]	49 [47, 51]	20 [19, 22]	24 [22, 25]	56 [54, 58]
Physical abuse	***Yes***	30 [24, 36]	22 [17, 28]	48 [41, 55]	16 [11, 22]	23 [17, 30]	61 [54, 68]
	No	24 [23, 26]	27 [25, 29]	49 [47, 51]	21 [19, 22]	24 [22, 26]	55 [53, 58]
Sexual abuse	***Yes***	27 [20, 35]	27 [21, 35]	46 [37, 54]	19 [14, 25)	24 [18, 30]	57 [50, 64]
	No	25 [23, 27]	27 [25, 29]	49 [47, 41]	20 [19, 22]	24 [22, 26]	56 [53, 58]

Figure A8. Distribution of waist circumference by number of adverse childhood events and sex

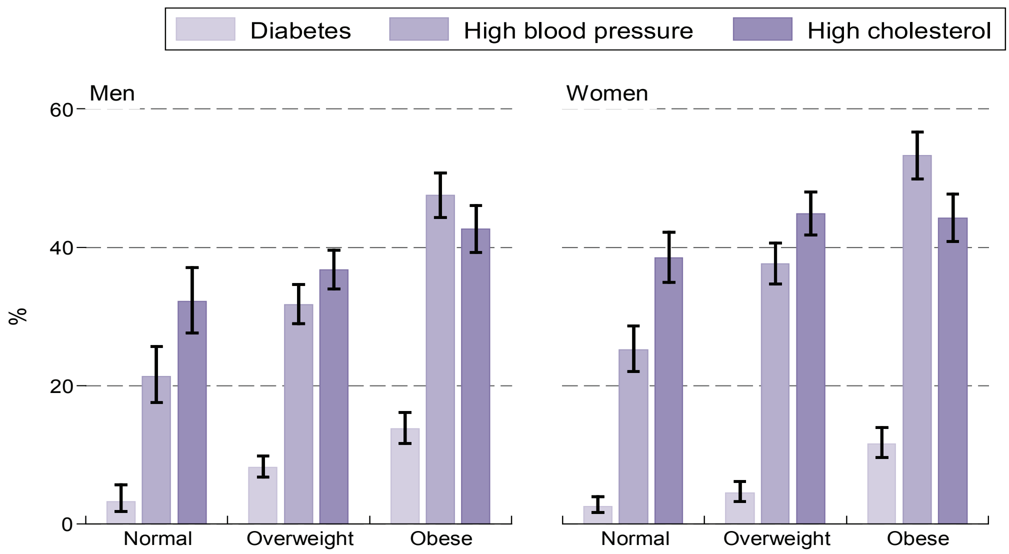


Note. N = 5135; Missing obs = 721; Error bars correspond to 95% confidence intervals

Table A9. Prevalence of cardiovascular disease by body mass index classification and sex

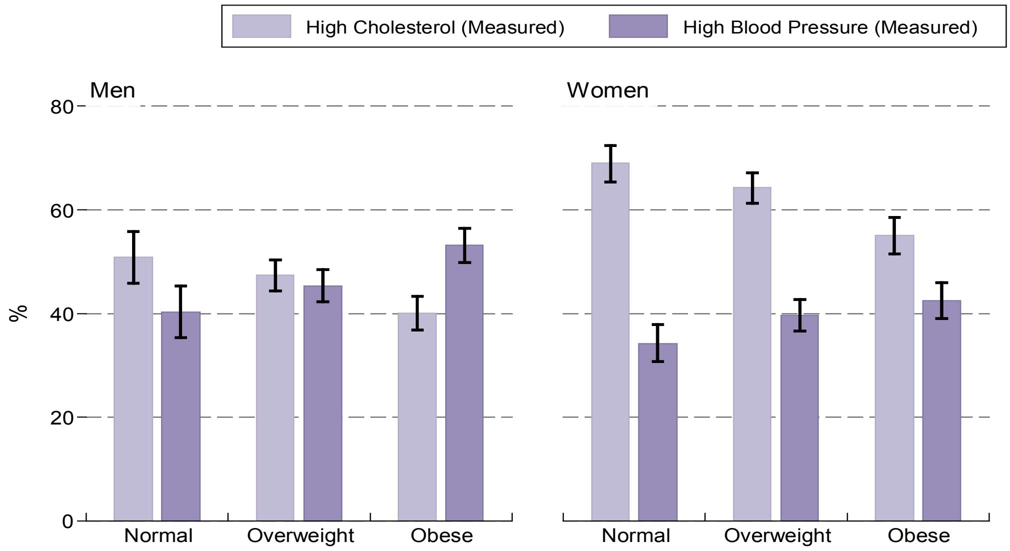
	Men % [95% CIs]			Women % [95% CIs]		
	Normal	**Overweight**	**Obese**	**Normal**	**Overweight**	**Obese**
Any Cardiovascular Disease	**13.9** [10.6, 17.9]	**16.2** [14.2, 18.5]	**20.2** [17.7, 22.9]	**11.2** [8.9, 13.9]	**14.0** [11.9, 16.3]	**16.5** [14.0, 19.5]
Angina	5.8 [3.8, 8.8]	6.3 [5.0, 7.9]	8.7 [7.0, 10.7]	3.7 [2.4, 5.7]	4.2 [3.0, 5.9]	6.5 [4.8, 8.8]
Heart Attack	5.4 [3.5, 8.2]	7.4 [5.9, 9.3]	9.1 [7.3, 11.1]	2.1 [1.2, 3.8]	2.2 [1.4, 3.4]	3.1 [2.0, 4.6]
Heart Failure	1.4 [0.6, 3.3]	1.0 [0.5, 1.8]	2.2 [1.4, 3.5]	0.4 [0.1, 1.8)	0.5 [0.2, 1.1]	1.2 [0.6, 2.4]
Stroke	2.4 [1.3, 4.6]	1.4 [0.8, 2.4]	2.2 [1.4, 3.5]	0.8 [0.3, 2.1]	1.9 [1.2, 3.1]	2.0 [1.2, 3.3]
Transient Ischemic Attack	2.9 [1.5, 5.2]	1.4 [0.9, 2.3]	2.9 [2.0, 4.3]	2.1 [1.2, 3.7]	2.2 [1.5, 3.4]	2.0 [1.2, 3.2]
Heart Murmur	3.3 [1.8, 5.8]	4.0 [3.0, 5.3]	4.4 [3.2, 5.8]	5.3 [3.9, 7.2]	5.6 [4.6, 7.6]	5.6 [4.2, 7.3]

Figure A10. Prevalence of doctor-diagnosed cardiovascular disease risk factors by body mass index classification and sex



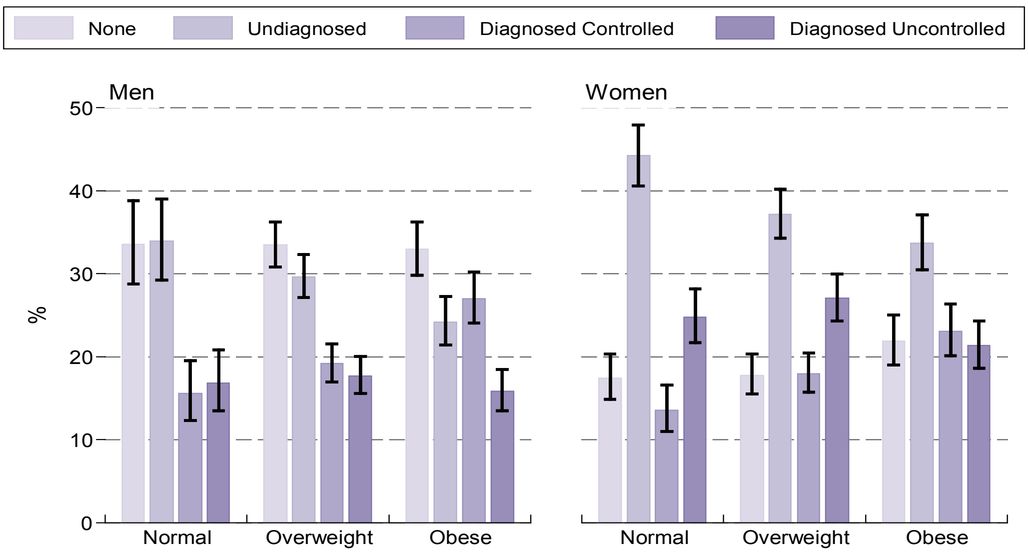
Note. N = 5824; Missing obs = 32; Error bars correspond to 95% confidence intervals

Figure A11. Prevalence of objectively measured high cholesterol and high blood pressure by body mass index classification and sex



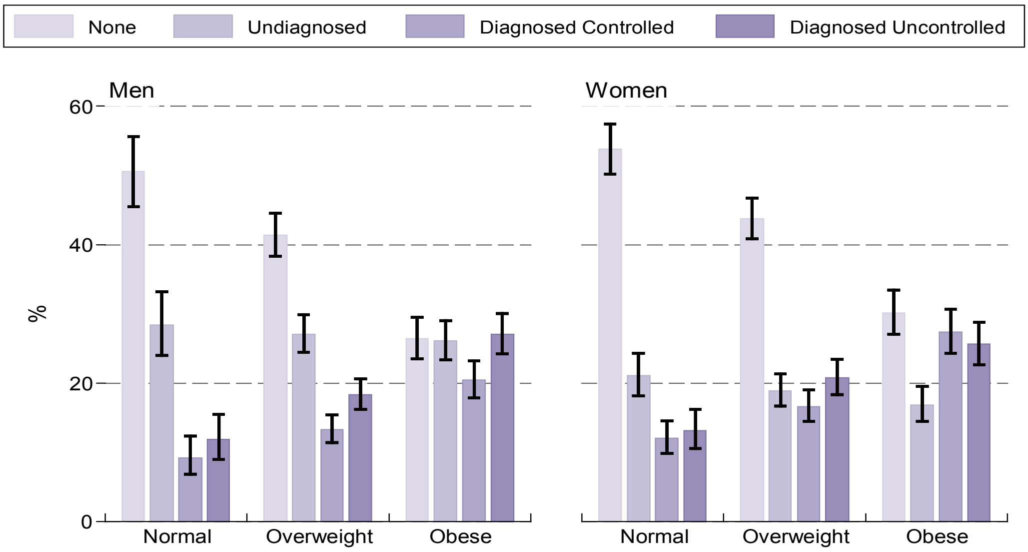
Note. N = 5547; Missing obs = 309; Error bars correspond to 95% confidence intervals

Figure A12. Prevalence of diagnosed and undiagnosed high cholesterol by body mass index classification and sex



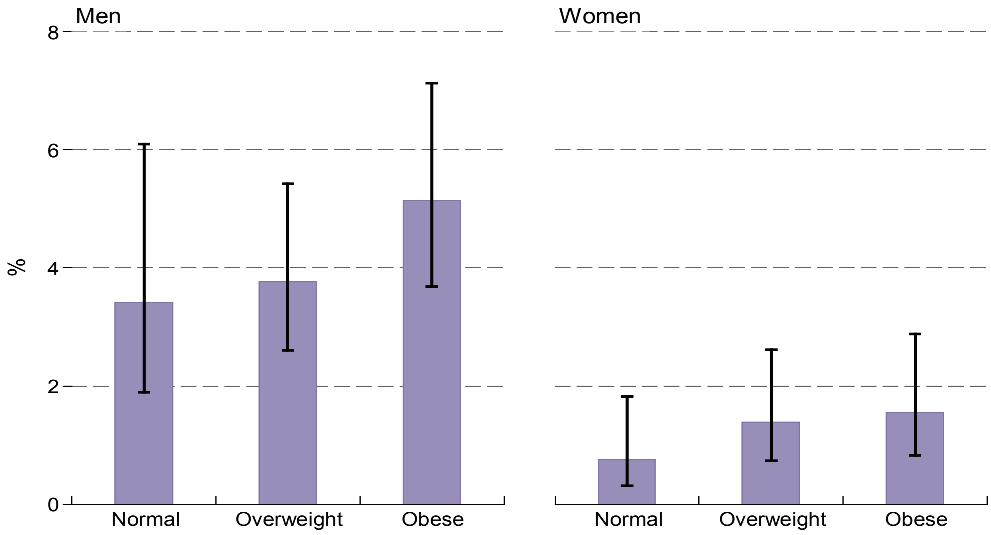
Note. N = 5576; Missing obs = 280; Error bars correspond to 95% confidence intervals

Figure A13. Prevalence of diagnosed and undiagnosed high blood pressure by body mass index classification and sex



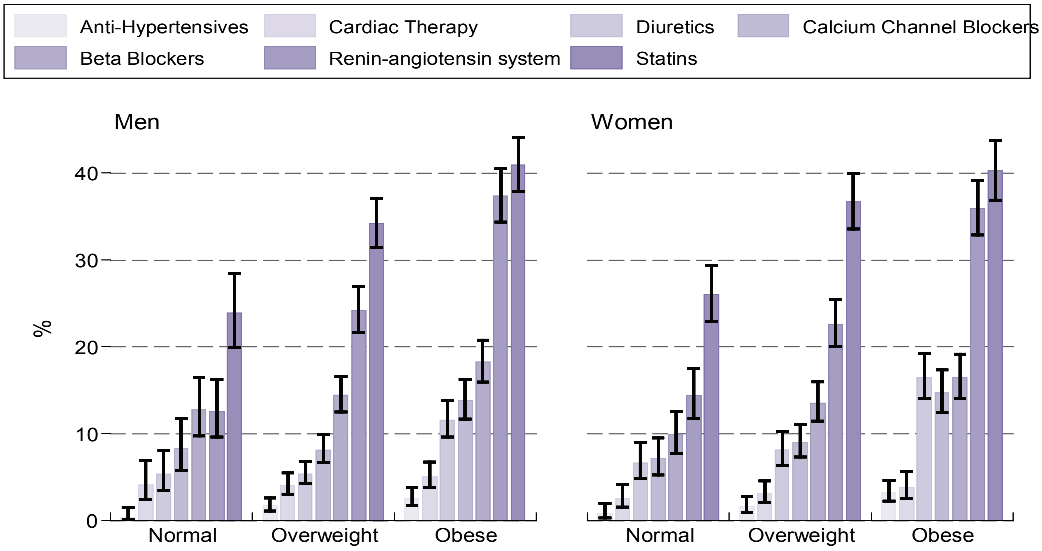
Note. N = 5793; Missing obs = 63; Error bars correspond to 95% confidence intervals

Figure A14. Prevalence of atrial fibrillation by body mass index classification and sex



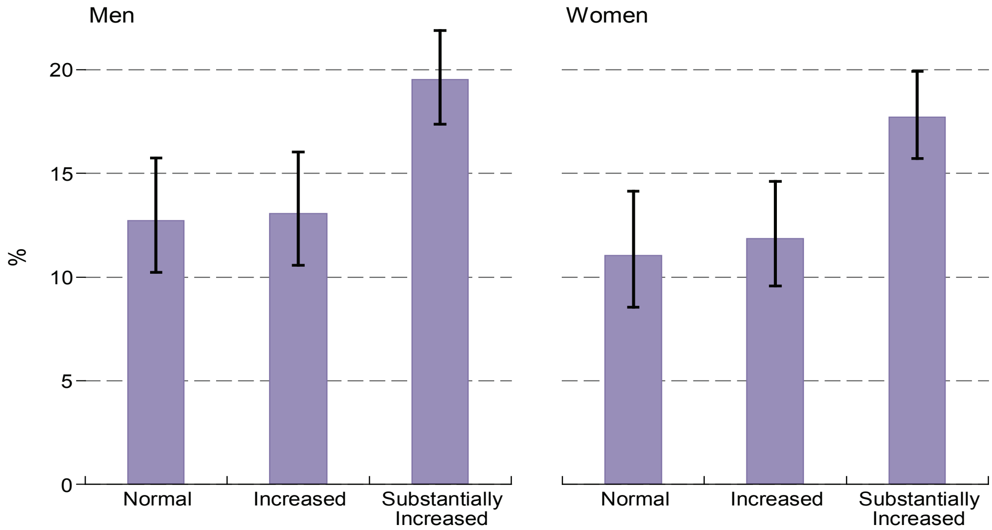
Note. N = 4852; Missing obs = 1004; Error bars correspond to 95% confidence intervals

Figure A15. Prevalence of prescribed cardiovascular medication use by body mass index classification and sex



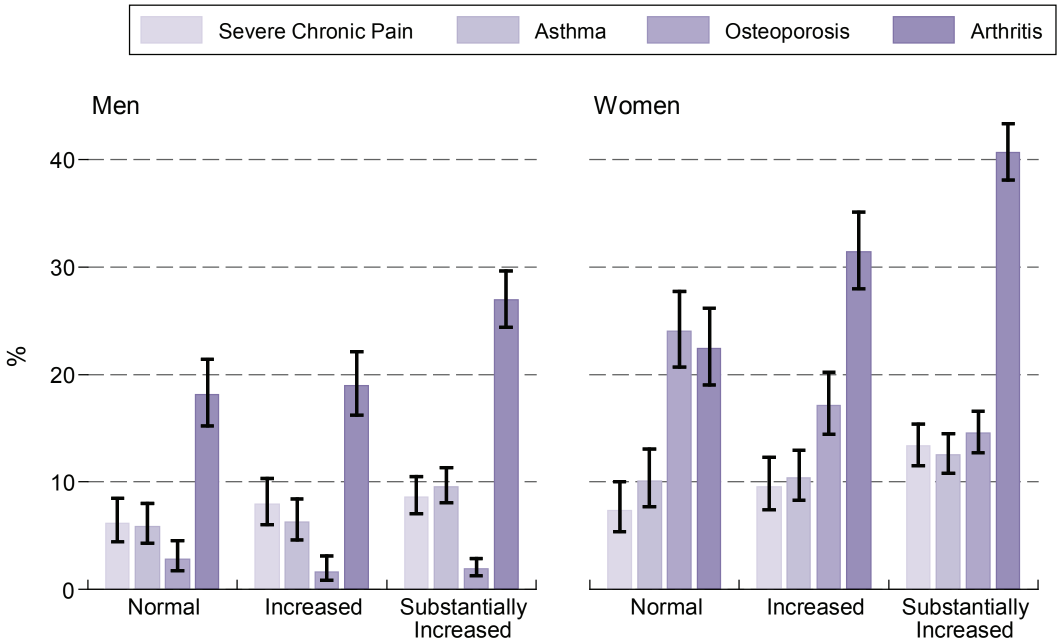
Note. N = 5824; Missing obs = 32; Error bars correspond to 95% confidence intervals

Figure A16. Proportion of TILDA participants rating their health as 'fair' or 'poor' by waist circumference classification and sex



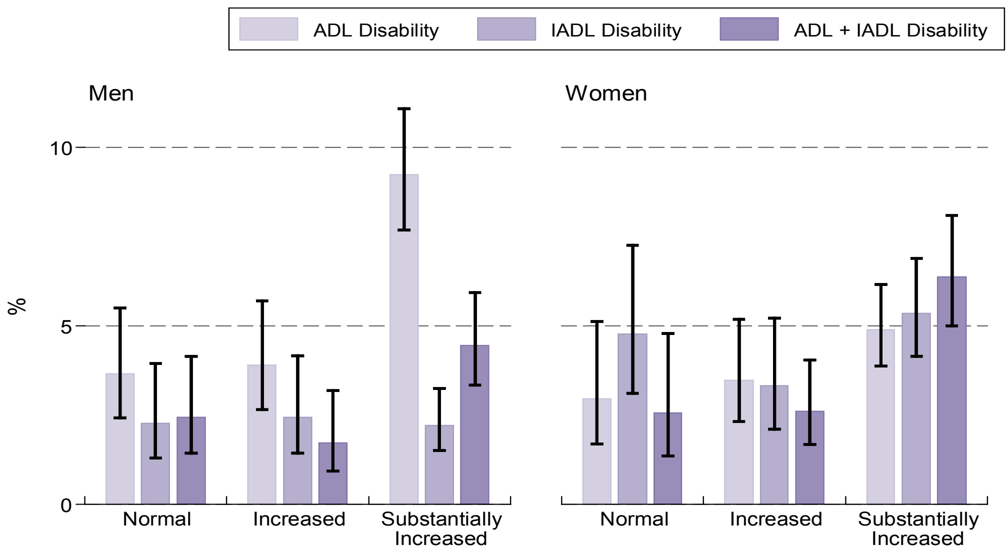
Note. N = 5846; Missing obs = 10; Error bars correspond to 95% confidence intervals

Figure A17. Prevalence of chronic health conditions by waist circumference classification and sex



Note. N = 5850; Missing obs = 6; Error bars correspond to 95% confidence intervals

Figure A18. Prevalence of ADL and IADL disability by waist circumference classification and sex

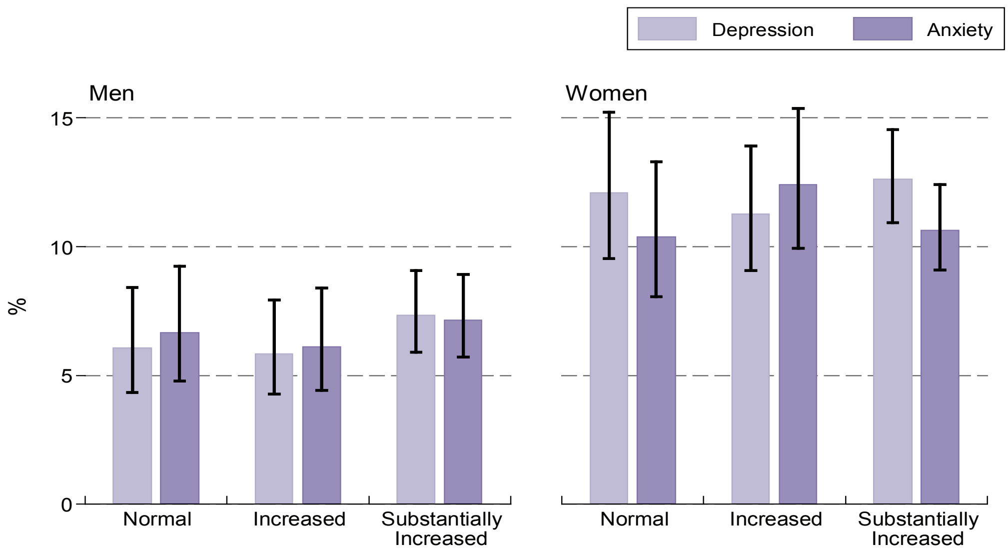


Note. N = 5856; Missing obs = 0; Error bars correspond to 95% confidence intervals

Table A19. Performance on measures of physical function by waist circumference classification and sex

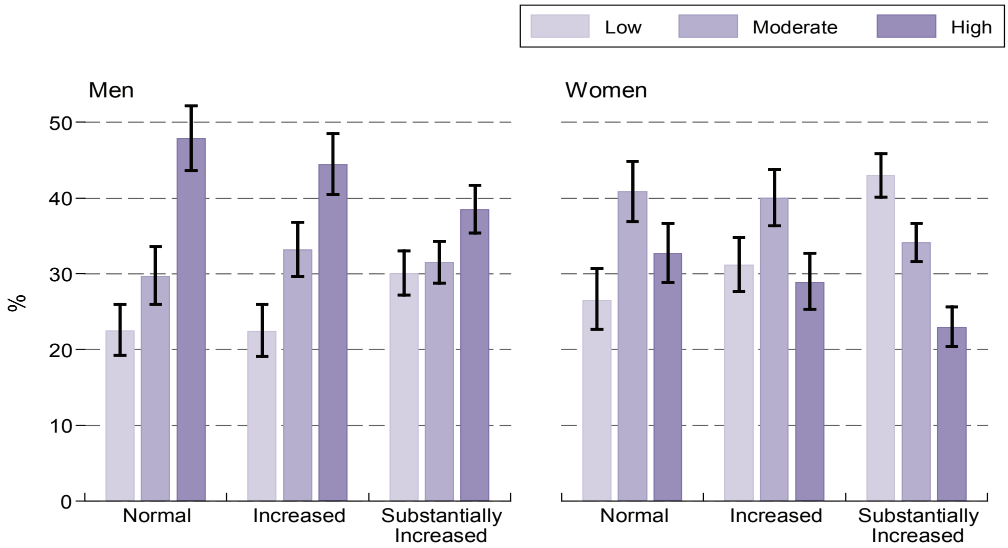
	Normal		Increased		Substantially Increased	
	Mean	[95% CIs]	Mean	[95% CIs]	Mean	[95% CIs]
Men						
Grip Strength (kg)	33.5	[32.7-34.2]	33.9	[33.2-34.6]	33.1	[32.5-33.6]
Gait Speed (cm/s)	140.9	[139.3-142.5]	139.6	[138.0-141.3]	134.0	[132.6-135.3]
Timed Up and Go (s)	8.8	[8.6-9.0]	8.9	[8.6-9.1]	9.8	[9.5-10.1]
Women						
Grip Strength (kg)	19.4	[18.9-19.8]	19.2	[18.8-19.6]	19.0	[18.7-19.3]
Gait Speed (cm/s)	139.9	[138.0-141.8]	135.5	[133.9-137.2]	127.8	[126.4-129.2]
Timed Up and Go (s)	8.6	[8.3-8.9]	8.9	[8.7-9.1]	10.5	[10.1-10.8]

Figure A20. Prevalence of clinically significant symptoms of anxiety and depression by waist circumference classification and sex



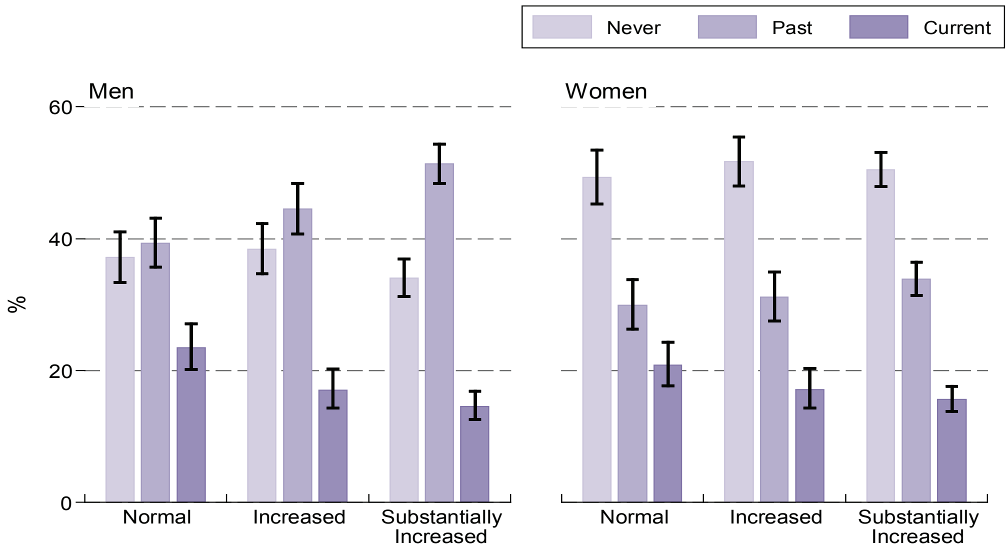
Note. N = 5109; Missing obs = 747; Error bars correspond to 95% confidence intervals

Figure A21. IPAQ physical activity level classification by waist circumference classification and sex



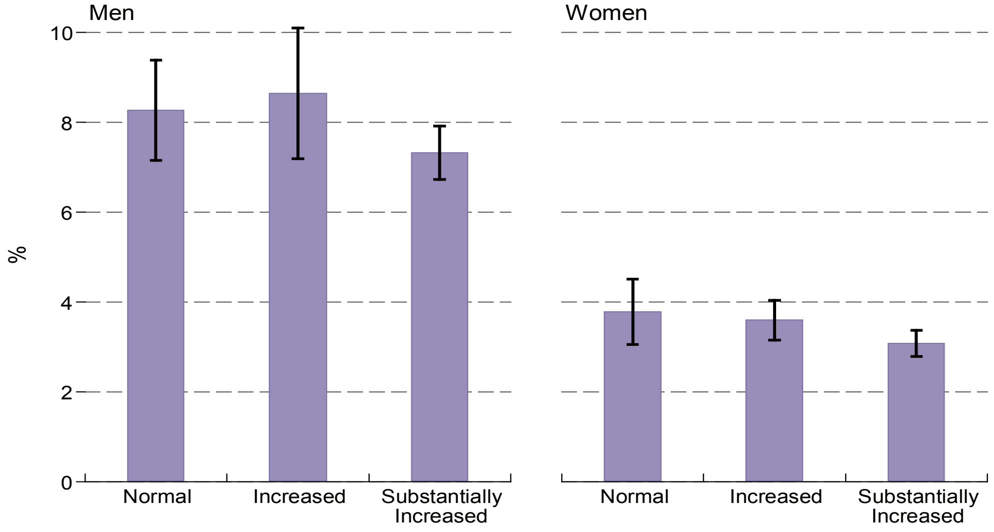
Note. N = 5807; Missing obs = 49; Error bars correspond to 95% confidence intervals

Figure A22. Smoking status by waist circumference classification and sex



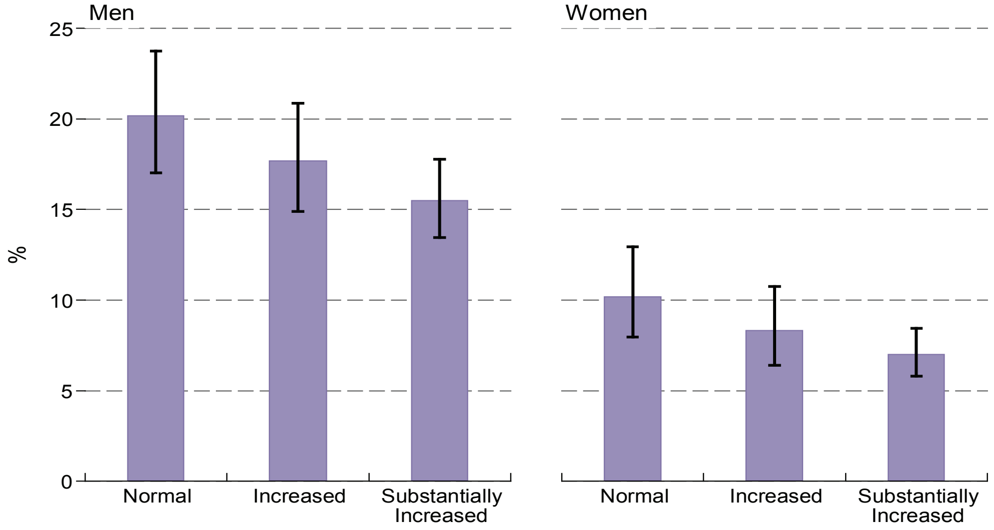
Note. N = 5856; Missing obs = 0; Error bars correspond to 95% confidence intervals

Figure A23. Average number of standard alcohol units consumed weekly by waist circumference classification and sex



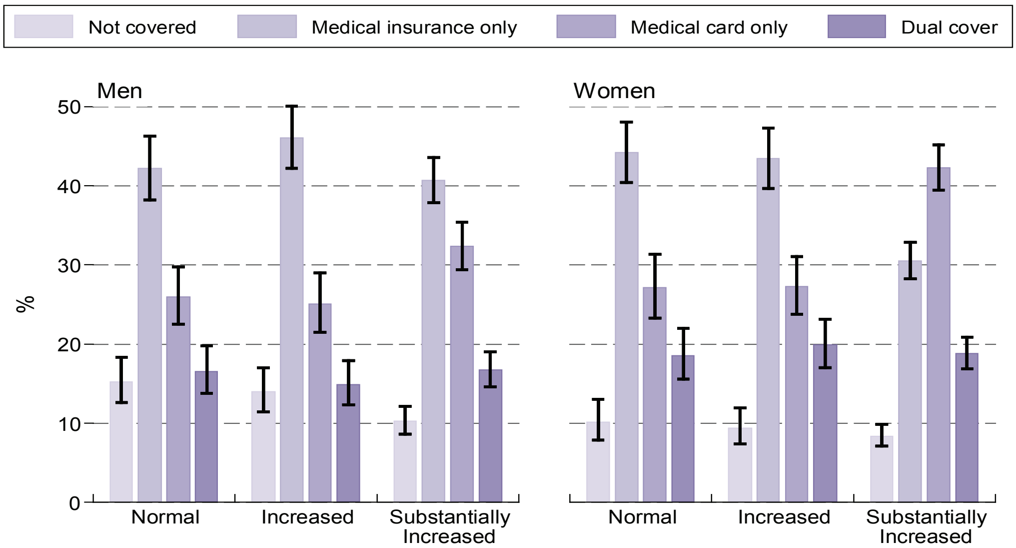
Note. N = 5014; Missing obs = 842; Error bars correspond to 95% confidence intervals

Figure A24. Prevalence of problematic alcohol consumption by waist circumference classification and sex



Note. N = 5233; Missing obs = 623; Error bars correspond to 95% confidence intervals

Figure A25. Distribution of health care entitlement status by waist circumference classification and sex

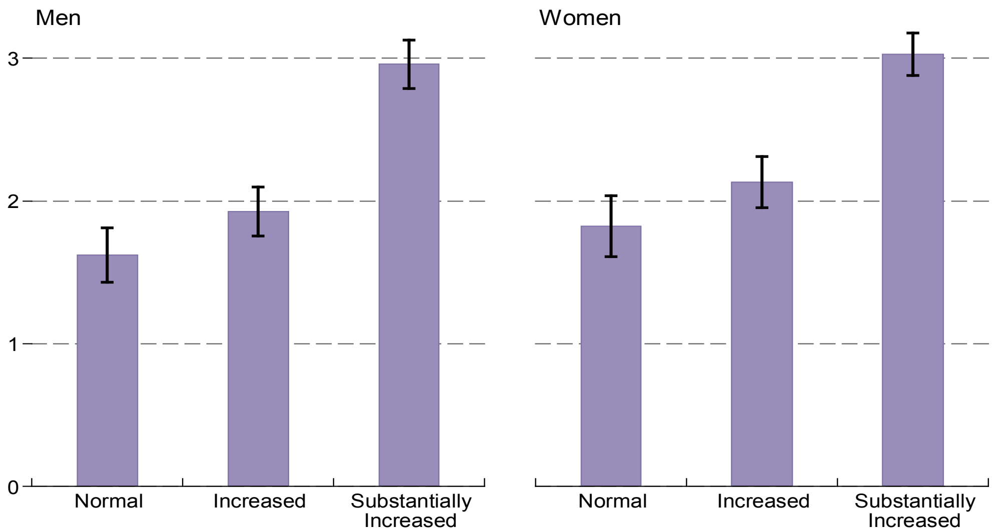


Note. N = 5852; Missing obs = 4; Error bars correspond to 95% confidence intervals

Table A26. Health service utilisation in the previous 12 months by waist circumference classification and sex

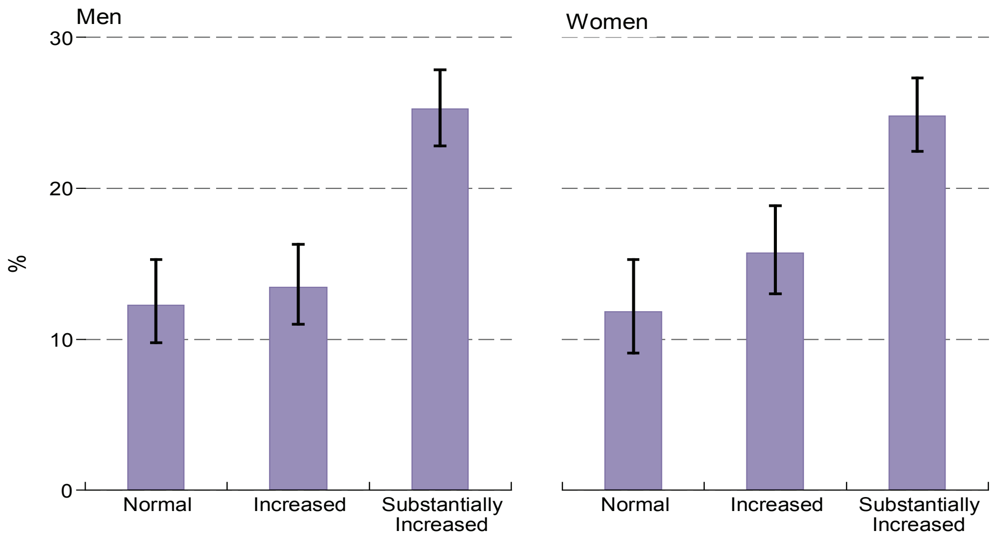
Type of Service	Normal		Increased		Substantially Increased	
Men						
GP visits, Mean [95% CI]	2.9	[2.5-3.2]	3.5	[3.1-3.8]	4.4	[4.1-4.7]
Outpatient visit, % [95% CI]	36.2	[32.6-40.0]	38.1	[34.4-42.0]	44.6	[41.4-47.7]
Emergency Department visit, % [95% CI]	14.6	[11.9,17.8]	15.9	[13.2-19.1]	15.9	[13.9-18.0]
Hospital Admissions, % [95% CI]	10.3	[8.0-13.1]	12.2	[9.8-15.0]	14.6	[12.8-16.7]
Women						
GP visits, Mean [95% CI]	3.1	[2.3-3.8]	3.5	[3.1-3.8]	4.6	[4.1-5.0]
Outpatient Visits, % [95% CI]	41.8	[37.6-46.1]	42.2	[38.4-46.1]	46.0	[43.2-48.7]
Emergency Department visits, % [95% CI]	14.5	[11.7-17.8]	15.0	[12.4-18.0]	15.8	[13.9-17.8]
Hospital Admission, % [95% CI]	10.1	[7.8-13.0]	13.3	[10.9-16.0]	13.8	[12.0-15.8]

Figure A27. Number of prescribed medications by waist circumference classification and sex



Note. N = 5820; Missing obs = 36; Error bars correspond to 95% confidence intervals

Figure A28. Prevalence of polypharmacy by waist circumference classification and sex



Note. N = 5820; Missing obs = 36; Error bars correspond to 95% confidence intervals